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Coverage of the subject has been restricted to that of Food Science and Technology Abstracts, which covers over 1200 of the important food journals, patents from 20 countries and books published world-wide. Every effort is made to include all significant references, but editorial discretion is used on the many articles of borderline interest. If the reader particularly needs an exhaustive search of the subject, we will be pleased to provide any other references that we have available. We would in any case encourage readers to write or telephone us with any comments or queries that they may have.

J. NEWTON,
ASSISTANT EDITOR

1
[Effect of nitrite and mild heat treatment on the inhibition of autolytic enzymes in lamb and in muscle tissue of the fresh water fish *Tilapia mossambica*.] Einfluss von Nitrit und von milder Wärmebehandlung auf die Hemmung autolytischer Enzyme in Lammfleisch und im Muskelgewebe des Süßwasserfisches *Tilapia mossambica*. Warriar, S. B. K.; Ninjoor, V.; Sawant, P. L.; Hirlekar, M. G.; Kumta, U. S. *Fleischwirtschaft* 53 (7) 980-982, 985 (1973) [15 ref. De, en, fr] [Biochem. & Food Tech. Div., Bhabha Atomic Res. Centre, Trombay, Bombay 85, India]

The lysosomal hydrolases aryl sulphatase (ARS), cathepsin (C) and β -glucuronidase (GRD) were used as marker enzymes in a study of inhibition of autolysis by combined nitrite treatment and mild heating. The purpose of the study was reduction of nitrite concn. used for preservation and possible development of less toxic substitutes. In homogenates of *Tilapia* muscle, heating for 2 h at 37°, 50° and 60°C caused no inhibition of ARS; at 60°C there was approx. 40% inhibition of GRD and 60% inhibition of C. A combination of 1 or 2 $\times 10^{-5}$ M NO_2^- and heating at 37°C caused 70% inhibition of ARS, 10% of GRD, 45% of C; at 50°C, approx. 80% of ARS, 25% of GRD, 40% of C; at 60°C, 85% of ARS, 60% of GRD, and 80-100% of C. In lamb muscle, a combination of 0.5 $\times 10^{-5}$ M NO_2^- and heat caused 77% inhibition of GRD at 50°C and of C at 60°C. Combinations of nitrite addition with heating were more effective than either alone. It is pointed out that any substitute for nitrite must suppress autolysis in addition to inhibiting bacteria and improving colour. RM

2

[Use of bacterial nitrite reductase in sausage manufacture.]

Solov'ev, V. I.; Prokosheva, G. A.

Prikladnaya Biokhimiya i Mikrobiologiya 9 (4) 512-515 (1973) [15 ref. Ru, en] [All-Union Res. Inst. of Meat Ind., USSR]

Use of nitrite reductase in the manufacture of sausage was studied with the aim of reducing the content of residual nitrite in the product. The intensity and stability of sausage colour were measured colorimetrically and microspectrally. The colorimetric method is based on assessment of the optical density of the acetone extract of nitrosopigment and total pigment. Use of nitrite reductase in the production of cooked sausage reduced the content of residual nitrite by 30-40%. AS

3

Effect of sodium nitrite and sodium nitrate on botulinal toxin production and nitrosamine formation in wieners.

Hustad, G. O.; Cerveny, J. G.; Trenk, H.; Deibel, R. H.; Kautter, D. A.; Fazio, T.; Johnston, R. W.; Kolari, O. E.

Applied Microbiology 26 (1) 22-26 (1973) [6 ref. En] [Oscar Mayer and Co., Madison, Wisconsin 53706, USA]

Wieners were formulated and processed approximating commercial conditions. 24 batches were made with 6 levels of NaNO_2 (0, 50, 100, 150, 200 and 300 $\mu\text{g/g}$), 4 levels of NaNO_3 (0, 50, 150 and 450 $\mu\text{g/g}$), and 2 levels of *Clostridium botulinum* (0 and 620 spores/g). After formulation, processing and vacuum packaging, portions of each batch were incubated at 27°C or held for 21 days at 7°C followed by incubation at 27°C for 56 days. The latter approximated distribution of product through commercial channels and potential temp. abuse at consumer level. Samples were analysed for botulinal toxin, nitrite, and nitrate after 3, 7, 14, 21, 28 and 56 days. When nitrite was not added, toxic samples were detected after 14 days at 27°C. At lowest level of nitrite, no toxic samples were observed until 56 days. Higher levels of nitrite completely inhibited toxin production throughout incubation. 9 uninoculated samples, representing various levels and combinations of nitrite and nitrate, were evaluated organoleptically. Flavour quality of wieners with nitrite was judged significantly higher ($P = 0.05$) than that wieners without nitrite. The 9 samples were negative for 14 volatile nitrosamines at a sensitivity level of 10 ng/g. Results indicated that nitrite effectively inhibited botulinal toxin formation at commercially employed levels in wieners and that detectable quantities of nitrosamines were not produced during preparation and processing for consumption. AS

4

Sodium ascorbate in meat products.

Klein, S.; Davidek, J.

Sbornik Vysoke Skoly Chemicko-Technologicke v Praze, E No. 34, 39-45 (1972) [5 ref. En, cs, ru] [Fac. of Food and Biochem. Tech., Inst. of Chem. Tech., Prague, Czechoslovakia]

The changes in sodium ascorbate (concn. of 0, 250, 500, and 1000 ppm) and sodium nitrite (concn. of 90, 180, 270, and 260 ppm) in canned pork meat were studied on storage at 5°C. One series of experiments was made in the presence of O_2 , the other after removal of O_2 using glucose oxidase and catalase. Samples were analysed after 4, 24, and 38 days of storage. The concn. of sodium nitrite decreased during storage, especially in those cases where high concn. of sodium ascorbate had been added. The residual concn. of sodium ascorbate decreased in the presence of a high initial concn. of sodium nitrite. This influence decreased gradually during storage and the residual sodium ascorbate concn. increased. The presence of O_2 influenced these reactions only at the beginning of the storage period. No difference between the samples stored for 38 days in the presence or absence of O_2 were found. AS

5

[Variation in nitrate and nitrite ions in foods. I. Determination of nitrate ion in foods by sodium salicylate method.]

Kawana, K.; Wada, Y.; Takahashi, T.; Kamijo, M.; Asakura, M.; Kawamura, T.; Kanno, S.

Journal of the Food Hygienic Society of Japan [Shokuhin Eiseigaku Zasshi] 12 (6) 506-511

(1971) [3 ref. Ja, en] [Kanagawa Prefectural Public Health Lab., 52-2 Naka-cho, Asahi-ku, Yokohama]

The following procedure was applied. Nitrate N is extracted from foods with distilled water at room temp. To an aliquot of the extract containing 5-20 µg of nitrate N, 1 ml of sodium salicylate-NaOH solution, 1 ml of ammonium sulphamate and 1 ml of 0.2% NaCl are added. The mixture is heated to dryness on a water bath. 2 ml of conc. H₂SO₄ and 20 ml of distilled water are added to the residue, which is then extracted with 20 ml of methyl isobutyl ketone. 10 ml of 1% NaOH solution is added to the organic solvent layer, the NaOH layer transferred to a 50 ml Nessler tube, and diluted to 30 ml with distilled water. The absorbance is measured at a wavelength of 415 nm. The recovery of nitrate was about 90% in analyses of vegetables and meat products. RM

6

The formation of carcinogenic nitroso compounds from nitrite and some types of agricultural chemicals.

Elespuru, R. K.; Lijinsky, W.

Food and Cosmetics Toxicology 11 (5) 807-817 (1973) [7 ref. En, fr, de] [Univ. of Tennessee - Oak Ridge Graduate School of Biomed. Sci. and the Carcinogenesis Program, Biol. Div., Oak Ridge Nat. Lab., Tennessee 37830, USA]

Many derivatives of urea and carbamic acid have been widely used in agriculture as pesticides and herbicides. These react with nitrite in mild acid conditions to form a dialkyl nitrosamine or an N-nitroso derivative or both. Yields of N-nitroso compounds in a variety of conditions (including those to which man might be exposed) and the effect of different chemical structures on the course of the reaction were investigated. Since nitrites are present in many foods, a carcinogenic hazard to man could exist when food containing residues of certain agricultural chemicals is simultaneously present in the stomach. VJG

7

[Model experiments on distribution of nitrites in pig meat pickled directly after slaughter and after cooling.]

Mroczek, J.; Wasilewski, S.; Izdebska, W.

Gospodarka Miesna 25 (7) 19-21 (1973) [10 ref. Pl]

Samples of semimembranes muscle taken from normal hams either (i) when still warm 4 h after slaughter or (ii) after cooling for 72 h at 2°C were pickled and examined as described in FSTA (1973) 3 15138, 10 replicates of (i) and (ii) being used. Values for nitrite gradients in (i) and (ii) are

graphically presented. Contents of nitrites in successive slices of the meat cylinders were significantly greater in (ii) than in (i). Mean values for nitrite contents for (i) and (ii) respectively were (mg%): decrease in brine, 25.58 ± 3.72 and 47.60 ± 7.58 ; and present in meat, 6.25 ± 1.92 and 9.13 ± 2.06 . It is considered that because of lower nitrite contents in (i) and unknown fate of the larger proportion of brine nitrites removed in the (ii) procedure, pickling directly after slaughter would be more suitable. [See also FSTA (1970) 2 7S612.] SKK

8

Induction of liver and lung tumours in rats by the simultaneous administration of sodium nitrite and morpholine.

Newberne, P. M.; Shank, R. C.

Food and Cosmetics Toxicology 11 (5) 819-825 (1973) [15 ref. En, fr, de] [Dept. of Nutr. & Food Sci., Massachusetts Inst. of Tech., Cambridge, 02139, USA]

In order to determine whether dietary nitrite, as the Na salt, and a secondary amine (morpholine) could induce liver and lung tumours identical to those induced by N-nitrosomorpholine (a preformed nitrosamine), Sprague-Dawley rats were fed dietary concn. (≤ 1000 ppm each) of nitrite and morpholine or 5 or 50 ppm N-nitrosomorpholine. Animals fed nitrite and morpholine at moderate to high concn. developed hepatocellular carcinomas and angiosarcomas, histologically identical to those induced by preformed N-nitrosomorpholine. These data support the concept that in vivo nitrosation does occur, presumably under the acidic conditions in the rat's stomach. VJG

9

Health laws and regulations - United Kingdom.

World Health Organization

International Digest of Health Legislation 23 (4) 887-907 (1972) [En] [Geneva, Switzerland]

A selection of United Kingdom health laws and regulations is presented including the following which relate to food hygiene: The Preservatives in Food (Amendment) Regulations 1971, S.I. 1971/882 (dated 25 May, 1971) impose limits on the amounts of sodium nitrate and sodium nitrite which may be added to bacon and ham, the amount of sodium nitrate added to pickled meat and the amount of sodium nitrite added to all pickled meat. Potassium nitrate and nitrite are subject to the same limits. VJG

10

Health laws and regulations - Israel.

World Health Organization

International Digest of Health Legislation 23 (4) 776-781 (1972) [En] [Geneva, Switzerland]

A selection of Israeli health laws and regulations is presented including the following which relate to food hygiene: the Public Health (Cyclamates) Rules, 1970 (dated 21 July, 1970) declare it unlawful to manufacture, import, sell or in any manner transfer to another person a foodstuff

containing cyclamate, (defined as cyclohexylsulphamic acid, calcium cyclohexylsulphamate or sodium cyclohexylsulphamate) but it is lawful to manufacture, import, sell and transfer cyclamate tablets provided certain requirements are fulfilled; the 1971 Amendment to the Public Health (Food Colorants) Rules 1963, adds Brilliant Blue FCF as synthetic colour Blue No. 3 to the list of approved synthetic colours; 1971 Amendment to the Public Health (Preservatives in Food) Regulations 1965, establishes a limit (500 ppm) for sodium nitrate in pickled, smoked, salted or preserved meat and fish products; 1971 Amendment to the Public Health (Emulsifiers and Stabilizers in Food) Regulations 1966, deletes brominated oils from the approved list; the Public Health Rules 1970 (dated 10 Oct., 1971) defines 'remnant of control agent' and considers tolerance of such residues. • VJG

11

Possible substitutes for nitrite for pigment formation in cured meat products.

Howard, A.; Duffy, P.; Else, K.; Brown, W. D. *Journal of Agricultural and Food Chemistry* 21 (5) 894-898 (1973) [18 ref. En] [Inst. of Marine Resources, Dept. of Food Sci. and Tech., Univ. of California, Davis, 95616, USA]

Various concn. of 24 nitrogenous ligands were examined for their ability to form ferrohaemochromes with bovine myoglobin at pH 5.0 or 6.0. Methyl and hexyl nicotinate and N,N-diethylnicotinamide were particularly effective. Methyl and hexyl nicotinate and N,N-diethylnicotinamide produced stable pink pigments in cooked ground meat mixtures. These compounds were also effective, as was trigonelline, in combination with 10 or 20 ppm of nitrite, in forming a stable and long-lasting pink cured meat colour in such systems. AS

12

Influence of nitrite and nitrate curing ingredients on quality of packaged frankfurters.

Simon, S.; Ellis, D. E.; MacDonald, B. D.; Miller, D. G.; Waldman, R. C.; Westerberg, D. O. *Journal of Food Science* 38 (6) 919-923 (1973) [23 ref. En] [Union Carbide Corp., Films-Packaging Div., Food Sci. Inst., Chicago, Illinois 60638, USA]

Triplicate all meat (beef and pork) and all beef frankfurters were prepared with 0, 1/16, 1/8 and 1/4 oz sodium nitrite/100 lb meat block and 0 and 1/4 oz sodium nitrate. The frankfurters were packaged with and without vacuum and stored at 4.5°C for as long as 4 wk. At selected storage intervals the various products were evaluated organoleptically and analysed for cured pigment conversion as well as general bacterial quality. The taste panel scores of all meat frankfurters without nitrite were low initially and became increasingly unacceptable with longer storage time. Raising the nitrite level improved acceptability throughout the storage period. The flavour of all beef frankfurters was not affected by lack of either nitrate or nitrite. Nitrates did not affect flavour or cured pigment conversion,

although cured colour formation was directly related to nitrite level. Total bacterial counts were not affected by nitrite levels or nitrate addition. Vacuum packaged frankfurters survived close to 2 wk longer than overwrapped frankfurters which spoiled in about 10 days. IFT

13

Changes in residual nitrite in sausage and luncheon meat products during storage.

Hill, L. H.; Webb, N. B.; Moncol, N. D.; Adams, A. T.

Journal of Milk and Food Technology 36 (10) 515-519 (1973) [15 ref. En] [Dept. of Food Sci., N. Carolina St. Univ., Raleigh, 27607, USA]

Changes in residual nitrite content of 18 sausage products during storage for various lengths of time are reported. Most pre-packaged processed meats (storage temp. $5 \pm 2^\circ\text{C}$) showed decreasing residual nitrite levels during storage. All dried meat products (storage temp. $24 \pm 1^\circ\text{C}$) showed increasing residual nitrite levels during storage. Residual nitrite decreased with cooking for the 3 products (smoked sausage, Polish sausage, frankfurters) evaluated. AS

14

Partial recovery of nitrite nitrogen by the Kjeldahl procedure in meat products.

Sebranek, J. G.; Cassens, R. G.; Hoekstra, W. G. *Journal of Food Science* 38 (6) 1085-1086 (1973) [10 ref. En] [Dept. of Meat & Animal Sci., Univ. of Wisconsin, Madison, 53706, USA]

Nitrite in meat products is at least partially recovered by the conventional Kjeldahl procedure but the amount recovered depends on the amount present. Low levels of nitrite gave 80-90% recovery and high levels gave 25-30% recovery. IFT

15

Use of sodium ascorbate or erythorbate to inhibit formation of N-nitrosodimethylamine in frankfurters.

Fiddler, W.; Pensabene, J. W.; Piotrowski, E. G.; Doerr, R. C.; Wasserman, A. E. *Journal of Food Science* 38 (6) 1084 (1973) [6 ref. En] [USDA E. Regional Res. Center, Philadelphia, Pennsylvania 19118, USA]

The effect of NaNO_3 , sodium ascorbate (NaAsc) and sodium erythorbate (NaEry) on N-nitrosodimethylamine (DMNA) formation in frankfurters made with 150 or 1500 ppm NaNO_2 was investigated. NaNO_3 , NaAsc or NaEry were added to the emulsion at their max. permissible levels and at 10 times these amounts. The frankfurters were cooked and smoked for either 2 or 4 h. Frankfurters prepared with 150 ppm NaNO_2 alone or with NaNO_3 , NaAsc or NaEry had no DMNA. With 1500 ppm NaNO_2 , which induced DMNA formation, NaNO_3 had no effect; however, use of NaAsc or NaEry prevented formation of DMNA in frankfurters processed for 2 h or reduced the amount formed after 4-h treatment. [See also FSTA (1973) 5 1S57 & 11S1256.] IFT

16

Potential precursors of N-nitrosopyrrolidine in bacon and other fried foods.

Bills, D. D.; Hildrum, K. I.; Scanlan, R. A.; Libbey, L. M.

Journal of Agricultural and Food Chemistry 21 (5) 876-877 (1973) [6 ref. En] [Dept. of Food Sci. and Tech., Oregon St. Univ., Corvallis, 97331, USA]

The possibility of producing N-nitrosopyrrolidine from several compounds in a system designed to simulate the frying of fatty foods containing small amounts of water was investigated. With the exception of tests on N-nitrosoproline, equimolar amounts of the compound to be tested and sodium nitrate were added to the system prior to heating. With a heat-up time of 10 min plus 10 min at 170°, N-nitrosopyrrolidine was produced from N-nitrosoproline, pyrrolidine, spermidine, proline, and putrescine in yields of 2.6, 1.0, 1.0, 0.4, and 0.04% theoretical, respectively. N-Nitrosopyrrolidine was not produced from glutamine, glutamic acid, and hydroxyproline. AS

17

[Investigation on reducing nitrite addition to meat products.] Untersuchungen zur Reduktion des Nitritzusatzes zu Fleischerzeugnissen.

Leistner, L.; Hechelmann, H.; Bern, Z.; Albertz, R. *Fleischwirtschaft* 53 (12) 1751-1754 (1973) [13 ref. De, en] [Bundesanstalt für Fleischforschung, 8650 Kulmbach, Federal Republic of Germany]

The effects of reduction of the nitrite content of curing salt on inhibition of Gram-negative pathogens in (i) fermented sausages (teewurst and cervelat), (ii) vacuum packaged Bologna sausage and (iii) curing brines were investigated. Mixed cultures of 10 strains of salmonellae, shigellae and enteropathogenic strains of *Escherichia coli* were used for inoculation of meat products containing 0, 50, 75 and 100% of the usual concn. of curing salts. Tables give details of changes in the bacterial count of (i) during maturation for 30 days, of (ii) during storage for 20 days at 8°C and of (iii) during curing for 12 days. Results showed that even in heavily contaminated products (10^4 - 10^5 cells/g) the nitrite concn. could be reduced by 25% without loss of inhibitory effects, and could be even further reduced at low levels of contamination, in the presence of glucono- δ -lactone, at low water activity values or in the presence of lactobacilli. Under favourable conditions, nitrite concn. required for adequate protection of (i), (ii) and (iii) are, respectively, 110, 65 and 400 ppm. RM

18

[The effect of the nitrite reductase system on the residual nitrite content of dry sausages, and its dependence on external conditions.] Der Einfluss des Nitratreduktasesystems auf den Restnitritgehalt in Rohwurst und seine Abhängigkeit von äusseren Bedingungen.

Pfeil, E.; Liepe, H.-U.

Fleischwirtschaft 53 (12) 1745-1747 (1973) [17 ref. De, en, fr] [Philipps Univ., 355 Marburg, Lahnberge, Federal Republic of Germany]

The activity of the nitrate reductase system of micrococci was studied with live bacteria and with crude enzyme preparations, in nutrient broth and in sausages. Nitrate reductase was pH dependent (optimum pH approx. 6.7) and required NADH. Nitrite formation by living bacteria is a first order reaction. The very steep decline in activity at pH <5 suggests the presence of several pH dependent enzyme systems, and a possible inhibition of NADH synthesis at low pH. To produce nitrate- and nitrite-free sausages, a rapid fall in pH should be prevented; for this reason, addition of large quantities of sugar and/or glucono- δ -lactone should be avoided. [See also FSTA (1973) 5 7S799.] RM

19

[Nitrosamines in foods. IX. Distribution of nitrite in various foods.]

Harada, M.; Nakamura, Y.; Tanimura, A. *Journal of the Food Hygienic Society of Japan [Shokuhin Eiseigaku Zasshi]* 13 (1) 36-40 (1972) [19 ref. Ja, en] [Nat. Inst. of Hygienic Sci., Kamiyoga 1-chome, Setagaya-ku, Tokyo, Japan]

Distribution of nitrite in vegetables, fruits, pickles, cereals, potatoes, juice, cheese, ham and sausage, canned fish, dried sardine, salmon roe and pollack roe was investigated. An exceptionally high content of nitrite, about 100 ppm, was detected in the liquid part of a type of Japanese pickle. Most of the fresh vegetables and fruits contained <1 ppm nitrite. The nitrite content of fresh spinach stored at 30°C rapidly increased up to as much as 17 ppm in 3 days and then suddenly decreased to about 1 ppm. The nitrite contents of 10 kinds of meat product were less than the limitation value approved by the Japanese Food Sanitation Law. The highest value among the 10 samples was 80 ppm in a red wiener sausage. [See FSTA (1974) 6 2C53 for part VIII.] TM

20

[Some hygiene effects of addition of sodium nitrite to meat products.]

Nilsson, G.; Erlandsson, G.-B.

Var Föda 25 (10) 178-187 (1973) [6 ref. Sv, en] [Food Lab., Nat. Food Administration, S-104 01, Stockholm, Sweden]

The effects of nitrite and heat treatment on pH, redox potential (E_h), aerobic bacterial count and *Clostridium perfringens* in cured, minced meat (for sausage making) containing 2.5% NaCl and 100, 150 or 200 mg/kg sodium for 45 or 90 min, and the samples were stored at 5°, 10° or 15°C for 5-20 days; *C. perfringens* was inoculated at a concn. of approx. 1000 spores/g. Compared with the controls (samples without sodium nitrite), nitrite delayed the growth of aerobic bacteria, as did longer heat treatment. The total aerobic count increased markedly in samples heated for 45 min and containing no or low concn. of nitrite; these samples also showed a marked change in pH (from

6.1 to 5.3) and E_h (from +161 to -69 mV) when stored at 15°C (although there was little change at the other storage temp.). It was concluded that, in order to retain a high E_h value and prevent the growth of *Cl. perfringens*, the concn. of nitrite that needs to be added increases as the pasteurization time and storage temp. are reduced. HBr

21

A note on the resistance of *Bacillus* spp., faecal streptococci and *Salmonella* to an inhibitor of *Clostridium* spp. formed by heating sodium nitrite.

Roberts, T. A.; Garcia, C. E.

Journal of Food Technology 8 (4) 463-466 (1973) [5 ref. En] [Meat Res. Inst., Langford, Bristol BS18 7DY, UK]

An inhibitor of *Clostridium* spp. formed by autoclaving sodium nitrite in a laboratory medium also inhibited, at pH 6.0, 9 of 14 strains of *Bacillus* spp. *B. circulans*, *B. polymyxa*, *B. macerans*, *B. pantothenicus* and *Bacillus F* were resistant. *Streptococcus durans* was inhibited but *Strep. faecium*, *Strep. faecalis* and *Strep. faecalis* var. *zymogenes* were not. *Salmonella typhimurium* was not inhibited. Spoilage of sub-lethally processed cured meats by *Bacillus* spp. is not a common problem, but spoilage has been reported due to *B. subtilis*, *B. cereus*, *B. megaterium* and *B. polymyxa* as well as the denitrifying strains like *Bacillus F*. Of these, *Bacillus F* and *B. polymyxa* were resistant to heated nitrite, and *B. subtilis* and *B. megaterium* were sensitive. It is therefore not clear whether heated nitrite plays any role in the stability of pasteurized cured meats. AS

22

Inhibition of growth of *Cl. botulinum* at different pH values by sodium chloride and sodium nitrite.

Roberts, T. A.; Ingram, M.

Journal of Food Technology 8 (4) 467-475 (1973) [30 ref. En] [Meat Res. Inst., Langford, Bristol BS18 7DY, UK]

The inhibitory combinations of pH (5.4-6.2), NaCl (0-7% w/v) and NaNO₂ (0-300 ppm) have been determined at 35°C in a laboratory medium for vegetative cells of *Cl. botulinum* types A, B, E and F. Inhibition of growth of *Cl. botulinum* is shown to be the result of interaction of all 3 factors and the importance of studies of this nature is discussed with reference to meat. AS

23

The production of an antimicrobial effect in pork heated with sodium nitrite under simulated commercial pasteurization conditions.

Ashworth, J.; Hargreaves, L. L.; Jarvis, B.

Journal of Food Technology 3 (4) 477-484 (1973) [9 ref. En] [British Food Manufacturing Ind. Res. Assoc., Randalls Road, Leatherhead, Surrey, UK]

The production of a thermally induced inhibitor, derived from nitrite, was first demonstrated in a laboratory medium by Perigo, Whiting & Bashford [*Journal of Food Technology* (1967) 2, 377] and

was subsequently confirmed by other workers.

Using modified techniques, Ashworth & Spencer [see FSTA (1972) 4 11S1513] demonstrated the production of a thermally induced inhibitor in minced pork, containing sodium nitrite, when given a sterilization heat treatment. This report describes work undertaken with model systems of pork which were pasteurized under conditions similar to those likely to be encountered in the commercial treatment of products such as large pasteurized canned hams. The results show that a thermally-induced inhibitor, derived from nitrite, was produced in the model systems. The inhibitory effect on spores of *Clostridium sporogenes* was similar whether these were heated with the meat or inoculated post processing. Under pasteurization conditions an effect could be seen both in terms of the input and the residual nitrite levels. The presence of NaCl at a level of 3.5% on the aqueous phase slightly reduced the levels of nitrite necessary to inhibit the spores. AS

24

Food additives. Nitrites and/or nitrates combined with spices in curing premixes.

United States of America, Food & Drug Administration

Federal Register 38 (221, Nov. 16) 31679-31680 (1973) [En] [Washington, DC]

Nitrosamines have now been found in buffered (with Na₂CO₃) curing mixes containing the title materials. Combinations of nitrites and/or nitrates with spices, and/or other flavouring or seasoning ingredients may not be used under the Federal Food, Drug and Cosmetic Act when packaged together. CAS

25

[Effect of nitrates in canned foods on corrosion of the cans.] [Review]

Ogorkiewicz, W.

Przemysl Spozywczy 27 (12) 546-549 (1973) [19 ref. Pl]

This review is restricted to nitrates in canned fruits and vegetables (including juices). The role of nitrates in the corrosion mechanism is discussed, and the contents of Sn found in 14 different types of fruit and vegetables are tabulated. HBr

26

¹⁵N tracer studies of nitrite added to a comminuted meat product.

Sebranek, J. G.; Cassens, R. G.; Hoekstra, W. G.; Winder, W. C.; Podebradsky, E. V.; Kielsmeier, E. W.

Journal of Food Science 38 (7) 1220-1223 (1973) [24 ref. En] [Coll. of Agric. & Life Sci., Univ. of Wisconsin, Madison, 53706, USA]

The stable isotope of N was used to study the fate and distribution of nitrite in a cured meat product. The meat product was fractionated into water soluble, salt soluble (protein) and insoluble forms in order to conduct quantitative analysis for

¹⁵N as a function of storage time up to 65 days and processing temp. of 0, 71°C and 107°C. Residual nitrite, determined 2 days after processing, accounted for less than half of the label added in frozen samples and in samples processed at 71°C. Samples processed at 107°C were initially very low in residual nitrite compared to the other heat treatments. The amount of label as nitrite decreased during storage in all samples. As residual nitrite decreased, the amount of label found in the non-nitrite water-soluble fraction and in protein fractions (both soluble and insoluble) increased. About 5% of the label was lost as a gas during processing and 9-12% was present in the pigment fraction. Total recovery of label ranged from 72 to 86%. IFT

27

Toxicants occurring naturally in foods. [Book]
Strong, F. M. (United States of America, National Research Council, Food Protection Committee,

Subcommittee on Naturally-Occurring Toxicants in Foods) (Chairman)

Second edition vii+624pp. ISBN 0 309 02117 0 (1973) [many ref. En] Washington, DC, USA, National Academy of Sciences Price \$10.50

Much new information on food safety has been included in this second edition. The subject matter in this report has been organized on the basis of the chemical nature of the materials considered. Chapters included are: Nitrates and nitrites, by D. W. Fassett (pp. 7-25, 81 ref.); Toxic effects of dietary NaCl and the protective effect of K, by G. R. Meneely (pp. 26-42, 80 ref.); Trace elements, by E. J. Underwood (pp. 43-87, 198 ref.); Natural radioactivity in the biosphere and foodstuffs, by C. L. Comar & J. H. Rust (pp. 88-105, 15 ref.); Toxic proteins and peptides, by W. G. Jaffe (pp. 106-129, 130 ref.); Amino acids of nutritional importance, by A. E. Harper (pp. 130-152, 98 ref.); Aminonitriles and amino acids not derived from proteins, by E. A. Bell (pp. 153-169, 87 ref.); Some vaso- and psychoactive substances in food: amines, stimulants, depressants, and hallucinogens, by W. Lovenberg (pp. 170-188, 75 ref.); Potential toxicity of food lipids, by F. H. Mattson (pp. 189-209, 134 ref.); Natural sulphur compounds, by C. H. VanEtten & I. A. Wolff (pp. 210-234, 147 ref.); Toxicity of the vitamins, by K. C. Hayes & D. M. Hegsted (pp. 235-253, 125 ref.); Antivitamins, by J. C. Somogyi (pp. 254-275, 161 ref.); Enzyme inhibitors in foods, by J. R. Whitaker & R. E. Feeney (pp. 276-298, 123 ref.); [Continued in following abstr.] VJG

28

[Nitrosamines in Italian meat products.]

Cantoni, C.; Acqua, V. I'; Renon, P.

Industria Alimentari 13 (1) 97-101, 104 (1974)

[38 ref. It]

Contents of nitrate, nitrite and nitrosamines were determined in many samples of meat products, including 20 mortadella sausage, 20 canned meat, 40 Milan ham, 20 chopped pork, 20 luncheon meat, 40 Milan salami, 30 liver sausage, 20 cooked shoulder, 20 cooked ham, 10 cooked tongue and 10 small sausage. Data are tabulated of max. and min. values found and of % of nitrosamine-positive samples. Nitrosamines could not be detected in the Milan hams, chopped pork or luncheon meat. When found in other products the quantities were minute and much below a possible toxic level; the max. individual figure recorded was 0.119 mg/kg in a single sample of cooked shoulder and other max. values ranged from 0.025 to 0.078 mg/kg. ELC

29

Behaviour of aflatoxins in some meat products.

Strzelecki, E. L.

Acta Microbiologica Polonica, B 5 (4) 171-177 (1973) [8 ref. En] [Vet. Hygiene Res. Sta., 80-316 Gdansk, Poland]

Aspergillus flavus can grow and produce aflatoxins in country cured ham (traces after 84 and 126 days of storage at 5° and 30.1°) and in salami (104.85 and 213.40 µg/100 g after 13 and 78 days of storage at various temp.). The recovery of added aflatoxins during the storage of meat products was: 16% in raw ham after 6 wk, 7% in country cured ham after 126 days, and 19% in salami after 78 days. Some chemicals like p-aminobenzoic acid, potassium sulphite, and potassium fluoride inhibited aflatoxin synthesis in salami (0.12 to 1.08 µg/100 g after 13 and 78 days of storage). Of curing ingredients, aflatoxin production was totally inhibited by potassium nitrate. Sodium nitrite stimulated their formation a little but the curing mixture was the best stimulator (242.5 µg vs. 0.12 µg/100 ml in control medium). Twice as much aflatoxin G₁ as B₁ (150.0 µg and 75.0 µg/100 ml, respectively) was found in the mixture. *Asp. ochraceus* inhibited the production of aflatoxins but *Penicillium miczynski* Zaleski stimulated their formation (4.79 µg and 258.0 µg/100 ml, respectively). A mixture of some specific mould strains inhibited formation of aflatoxins (0.93 µg/100 ml). AS

30

[Problems of colour in cooked hams.]

Cantoni, C.; Maccapani, M.; Calcinardi, C.

Industria Alimentari 13 (1) 81-89 (1974) [23 ref. It]

A preliminary discussion is presented on factors influencing description of colour (tint, intensity, brightness), methods of measurement (transmission, reflectance), arbitrary colour units, and the chemical roles of myoglobin, oxymyoglobin, metmyoglobin, globins, nitrate and nitrite and Fe²⁺ and Fe³⁺ in meat pigmentation. Samples were examined from 6 samples of cured cooked shoulder and 11 manufactured hams, in each case including 4 different muscles, and using fresh meat as controls; all were from Large White pigs of the same wt. Detailed results are tabulated

of cured ham, between different free haem groups, nitrate and nitrite contents and values at different depths in the same muscle, together with analyses of variance for each pigment group. The analytical method of Hornsey [J. Sci. Food Agric. (1956) 7, 534] was used. Significant differences in contents of total pigments, nitroso pigments and free haems were found between shoulder meat and prepared hams, between different muscles of the same sample, and between different layers of the same muscle. ELC

31

[Comments on new meat regulations.]

Anmerkungen zur neuen Fleisch-Verordnung. Kreuzer, W.; Ring, C.; Kotter, L. *Schlacht- und Viehhof-Zeitung* 73 (9) 328-333 (1973) [De, fr] [Bereich Hygiene und Tech. der Lebensmittel Tierischen Ursprungs, Univ., Munich, Federal Republic of Germany]

The new regulations for meat and meat products in the Federal Republic of Germany are critically discussed, including regulations for the following aspects: cutting aids for use in sausage manufacture; use of calcium citrate for control of coagulation of blood; substances for use in the manufacture of edible synthetic sausage casings; antioxidants in edible fats of animal origin; use of talcum powder for surface treatment of non-edible casings of air-dried sausages; smoking of meat products; use of KNO_3 ; changes in the list of prohibited additives; and changes in the labelling regulations. AJDW

32

[1973 German Food Chemists' Congress, Bochum, Sept. 19-21.] Deutscher Lebensmittelchemikertag 1973 in Bochum, 19. bis 21. September. Germany, Federal Republic of, Gesellschaft Deutscher Chemiker, Fachgruppe Lebensmittelchemie und Gerichtliche Chemie *Mitteilungsblatt der GDCh-Fachgruppe Lebensmittelchemie und Gerichtliche Chemie* 28 (1/2) 1-104 (1974) [66 ref. De]

The full texts or abstracts are given of papers delivered at the above Congress, held under the auspices of the Food Chemistry and Juridical Chemistry Specialist Group of the Society of German Chemists. They include: New ways of obtaining environmentally compatible packaging films with enhanced food protection properties by chemical modification of cellophane, by H. Niebergall (pp. 21-30, 14 ref.); Nitrite [in meat] as an analytical problem, by K. Möhler (pp. 54-55); Automatic hydroxyproline and total protein determination in meat and meat products, by W. Arneith (pp. 55-56); Quality control in the meat products industry, by K. Rösler (pp. 56-60); Determination and incidence of carcinogenic polycyclic hydrocarbons in meat products, by L. Toth (pp. 60-66, 10 ref.); Use of density gradient-centrifugation for analysis of adjuncts in meat product manufacture, by A. Montag (p.66); German corned beef, by R. Ristow (pp. 66-73, 5 ref.); Use of statistical methods in the evaluation

of wines and spirits, by U. Haevecker (pp. 77-80, 2 ref.); Evaluation of fresh bakery products, by G. E. Halder (pp. 81-85); [continued in following abstr.] HBr

33

[1973 German Food Chemists' Congress, Bochum, Sept. 19-21.] Deutscher Lebensmittelchemikertag 1973 in Bochum, 19. bis 21. September. Germany, Federal Republic of, Gesellschaft Deutscher Chemiker, Fachgruppe Lebensmittelchemie und Gerichtliche Chemie *Mitteilungsblatt der GDCh-Fachgruppe Lebensmittelchemie und Gerichtliche Chemie* 28 (1/2) 1-104 (1974) [De]

[Continued from preceding abstr.] Sorption of volatile aroma compounds on sugar, by H. G. Maier & H. P. Thier (pp. 85-88, 6 ref.); α -Amylase from hens' eggs, by H.-J. Stan & J. Hasenjaeger (pp. 88-91, 4 ref.); Enzyme inhibitors in foods of vegetable origin, by K. Santarius & K.-P. Kahl (pp. 91-98, 20 ref.); Content of free amino acids in sour cherry juice as a function of the manufacturing technique used, by G. Baumann & K. Gierschner (pp. 98-99); Gas chromatographic analysis of the reaction products during the oxidation of L-ascorbic acid, by K. Pfeilsticker & F. Marx (p.100); and Rapid, automatic, kinetic determination of nitrite [in foods] in the nmol range, by E. Schwerdtfeger (pp. 100-104, 5 ref.). HBr

34

Nitrite in meat. Effect of various compounds on loss of nitrite.

Fox, J. B., Jr.; Nicholas, R. A. *Journal of Agricultural and Food Chemistry* 22 (2) 302-306 (1974) [31 ref. En] [E. Regional Res. Center, USDA, Philadelphia, Pennsylvania 19118, USA]

Various compounds endogenous to meat or added to cured meats, and known to react with nitrite, were tested in meat slurries for their effects on nitrite loss. The reductants, ascorbate and cysteine, and the amino acid, histidine, caused the only important losses when added to endogenous or normally used concn. Reduced nicotinamide adenine dinucleotide caused a short term reduction of nitrite, but the loss was not permanent. Kinetic data show that loss of nitrite is related to the reduction reaction which produces NO. Production of the latter accounts for a large part of total nitrite loss and evidence indicates that most or all of the remaining nitrite not accounted for is involved in the formation of nitroso-reductant intermediates or products. AS

35

Oxidation induced colour and flavour changes in meat.

Greene, B. E.; Price, L. G. *Abstracts of Papers, American Chemical Society* 167, AGFD 40 (1974) [En] [Dept. of Food and Nutr., School of Home Economics, Univ. of Georgia, Athens, 30601, USA]

Background information on effects of haem pigment-unsaturated fatty acid co-oxidations on colour and flavour of meat is reviewed. Special emphasis is placed on contrasting evidence for the significance of the state of the haem iron in haem catalysed lipid oxidation. Current research is presented in relation to the above. This work includes data on effects of NaNO_2 , pH and various additives on both haem and lipid oxidations in relation to colour and flavour changes in meat. AS

36

Effect of sodium ascorbate and sodium nitrite on toxin formation of *Clostridium botulinum* in wieners.

Bowen, V. G.; Cervený, J. G.; Deibel, R. H. *Applied Microbiology* 27 (3) 605-606 (1974) [1 ref. En] [Dept. of Bact., Univ. of Wisconsin, Madison, 53706, USA]

Toxin production by *Cl. botulinum* was inhibited by NaNO_2 levels $>50\mu\text{g/g}$ of wiener. Sodium ascorbate at levels of 105 and 655 $\mu\text{g/g}$ of product neither decreased nor potentiated the effectiveness of the NaNO_2 inhibition. The results indicate that the use of sodium ascorbate in vacuum-packaged wieners does not appreciably alter the inhibition of *Cl. botulinum* toxin formation by NaNO_2 . AS

37

Volatile flavor constituents of pork cured with and without nitrite.

Swain, J. W.

Dissertation Abstracts International, B 34 (3) 1143: Order no. 73-21836 (1973) [En] [Univ. of Missouri, Columbia, USA]

Sensory studies showed a significant ($P<0.05$) difference between the flavours of (i) nitrite-treated and (ii) non-nitrite treated hams. The TBA values of cooked (ii) increased more rapidly than those of (i), indicating lipid oxidation above the rancidity odour threshold after 4 days storage at 7.2°C . Cooked (i) samples were stable to haem-catalysed lipid oxidation for 2 wk at 7.2°C , but were less stable when ground before storage. Analysis of flavour volatiles showed no qualitative differences, but (ii) contained larger amounts of certain autoxidation products. Compounds identified included fatty acids, aldehydes, alcohols, ketones, furans, disulphides, thiolanes and other organic S compounds. AJDW

38

Instability of sodium nitrite in a chemically defined microbiological medium.

Riha, W. E.; Solberg, M.

Journal of Food Science 38 (1) 1-3 (1973) [11 ref. En] [Dept. of Food Sci., Rutgers St. Univ. of New Jersey, New Brunswick, 08903, USA]

Mixtures of NaNO_2 , amino acids and ascorbic acid at pH 6.3 or 7.2 were filter sterilized or heated for various times at 121°C . Samples were analysed for nitrite concn. immediately after treatment and

after storage at 37 or 43°C . Heating the complete medium for 15 min at 121°C reduced the nitrite concn. by 30-50% independent of the initial nitrite concn. Storage of complete filter sterilized medium at 43°C for 18-24 h resulted in 50-65% loss of nitrite while in heat sterilized medium the loss was as great as 90%. None of the 19 amino acids stored individually with NaNO_2 at 37°C for up to 4 h affected the nitrite concn., whereas ascorbic acid resulted in total disappearance of nitrite. During heating at 121°C , of the 19 amino acids only cystine resulted in any significant nitrite loss after 15 min of treatment while ascorbic acid affected total nitrite disappearance after 5 min. The defined medium containing nitrite demonstrated inhibitory activity against 7 strains of *Clostridium perfringens*. IFT

39

Formation of N-nitrosamines in low moisture systems.

Gray, J. I.; Dugan, L. R., Jr.

Journal of Food Science 39 (3) 474-478 (1974) [31 ref. En] [Dept. of Food Sci. & Human Nutr., Michigan St. Univ., East Lansing, 48823, USA]

Experiments have shown that N-nitrosamines can be formed when sodium nitrite and dialkylamines are heated in low-moisture model systems. Parameters which may influence the reaction were investigated. Results revealed that max. N-nitrosamine formation depended on temp. and time of heating, sodium nitrite-amine ratio and pH of the system. IFT

40

[Nitrites and nitrates in foods.] [Review]

Cantoni, C.; D'Aubert, S.

Industria Alimentari 13 (5) 81-92 (1974) [60 ref. It, en] [Istituto Ispezione Alimenti Animali, Univ. di Milano, Italy]

41

Effect of sodium nitrite on toxin production by *Clostridium botulinum* in bacon.

Christiansen, L. N.; Tompkin, R. B.; Shäparis, A. B.; Kuepper, T. V.; Johnston, R. W.; Kautter, D. A.; Kolari, O. J.

Applied Microbiology 27 (4) 733-737 (1974) [5 ref. En] [Swift & Co., Res. and Development Centre, Oak Brook, Illinois 60521, USA]

Pork bellies were formulated to 0, 30, 60, 120, 170, or 340 μg of nitrite/g meat and inoculated with *Clostridium botulinum* via pickle or after processing and slicing. Processed bacon was stored at 7 or 27°C and assayed for nitrite, nitrate and botulinal toxin at different intervals. Nitrite levels declines during processing and storage. The rate of decrease was more rapid at 27 than at 7°C . Although not added to the system, nitrate was detected in samples during processing and storage at 7 and 27°C . The amount of nitrate found was related to formulated nitrite levels. No toxin was found in samples incubated at 7°C throughout the

84-day test period. At 27°C, samples with low inoculum (210 Cl. botulinum/g before processing and 52/g after processing) became toxic if formulated with ≥ 120 μg of nitrite/g of meat. Toxin was not detected in bacon formulated with 170 or 340 μg of nitrite/g meat under these same conditions. Toxin was detected at all formulated nitrite levels in bacon inoculated via the pickle with 19 000 Cl. botulinum/g (4300/g after processing) and in samples inoculated after slicing. However, increased levels of formulated nitrite decreased the probability of botulinal toxin formation in bacon inoculated by both methods. AS

42

[The retention of nitrite in meat products. II. Investigations into the chemical and bacteriostatic properties of various nitrite reaction products.]

Über den Verbleib von Nitrit in Fleischwaren. II.

Untersuchungen über chemische und bakteriostatische Eigenschaften verschiedener Reaktionsprodukte des Nitrits.

Mirna, A.; Coretti, K.

Fleischwirtschaft 54 (3) 507-510 (1974) [24 ref. De, en, fr] [Bundesanstalt für Fleischforschung, 8650 Kulmbach, Blaich 4, Federal Republic of Germany]

The reaction products of nitrite with compounds present in meat were examined for free and bound NO_2 (after denitrosation with Hg^{2+}), and tested for their bacteriostatic action (Perigo effect) and reddening action. Addition of (i) black Roussin salt ($\text{NH}_4[\text{Fe}_4\text{S}_3(\text{NO})_6\text{NO}_2]$) to Frankfurter-type and dry sausage mixtures at concn. of 8-156 ppm resulted in formation of a bright red pigment which was not stable during heating and maturation of the sausages. Details are given of the % nitrosomyoglobin content and % reddening in sausages made with (i), or with (ii) nitrite curing salts. Samples made with (i) had a higher % nitrosomyoglobin than those made with (ii), but (ii) had a greater reddening action. (i) was bacteriostatic to micrococci and enterobacteria at a concn. of 1 ppm; this bacteriostatic effect was reduced in the presence of 5% meat press juice. [See FSTA (1970) 2 8S676 for part I.] RM

43

Effect of sodium nitrite concentration on the formation of nitrosopyrrolidine and dimethylnitrosamine in fried bacon.

Sen, N. P.; Iyengar, J. R.; Donaldson, B. A.; Panalaks, T.

Journal of Agricultural and Food Chemistry 22 (3) 540-541 (1974) [15 ref. En] [Food Res. Lab., Health Protection Branch, Dept. of Health and Welfare, Ottawa, Ontario K1A 0L2, Canada]

Fried bacon samples prepared with 0, 50, 100, 150 and 200-ppm levels of NaNO_2 were analysed for nitrosopyrrolidine and dimethylnitrosamine. The samples prepared without any added nitrite were negative, but all the fried samples with added

nitrite contained detectable levels (2-20 parts/billion) of nitrosamines. The levels of nitrosopyrrolidine correlated well with the initial concn. of nitrite but not with that of nitrite found in the raw bacon just prior to frying. The identity of nitrosopyrrolidine in a few samples was confirmed by GLC-MS. AS

Comparison of salami sausage produced with and without addition of sodium nitrite and sodium nitrate.

Skjelkvale, R.; Tjaberg, T. B.; Valland, M.

Journal of Food Science 39 (3) 520-524 (1974) [11 ref. En] [Norwegian Food Res. Inst., Box 50, 1432 As-NLH, Norway]

Pilot plant production of salami dry sausage with and without addition of nitrite was carried out. Microbiological, rheological and organoleptic properties of products were investigated during fermentation and after storing products at 20°C for 3 months. Results of microbiological investigation indicate that fermentation and ripening of sausage would take a normal course without addition of nitrite, glucono-delta-lactone (GDL) or starter culture. In a triangle test performed at the end of the ripening period, the taste panel was unable to distinguish between products with and without nitrite. After 3 months' storage a significant difference was found between products with and without addition of nitrite, and nitrite-cured products were given the best score. In series in which GDL or starter culture was added, no significant differences in organoleptic quality were found even after storage for 3 months. IFT

45

Effect of nitrite and storage temperature on the organoleptic quality and toxinogenesis by *Clostridium botulinum* in vacuum-packed side bacon.

Collins-Thompson, D. L.; Chang, P. C.; Davidson, C. M.; Larmond, E.; Pivnick, H.

Journal of Food Science 39 (3) 607-609 (1974) [17 ref. En] [Microbiol. Div., Food Res. Lab., Health Protection Branch, Tunney's Pasture, Ottawa, Ontario, K1A 0L2, Canada]

In 2 series of experiments (A and B) bacon packs were prepared with levels of 0, 50, 100, 150 and 200 ppm nitrite and inoculated with Cl. botulinum at 10^2 spores/g and 10^4 spores/g. Packs A were incubated at 20 and 30°C and packs B at 30°C only. Both were held for a max. of 32 days and analysed for toxin at intervals of 2, 4, 8, 16 and 32 days. At 20°C, none of the controls without nitrite was found to be toxic after 32 days. At 30°C, inhibition of toxin formation at the higher nitrite levels was observed at 32 days. Organoleptic evaluation of the bacon packs stored at 30°C showed about one-third of the toxic samples examined were acceptable to the panel. IFT

[Nitrosamines in foods.] Über Nitrosamine in der Nahrung.

Heyns, K.

Veröffentlichung, Arbeitsgemeinschaft

Getreideforschung eV No. 150, 45-54 (1973) [26 ref. De]

The occurrence of carcinogenic nitroso compounds (especially nitrosamines) in foods is discussed, with reference to literature data. Aspects covered include: reactions leading to formation of nitrosamines; the concn. of nitrosamine precursors (nitrates, nitrites and secondary amines) in various foods; the biological mechanism of the carcinogenic activity of nitrosamines; and methods of quantitative analysis of nitrosamines. AJDW

Nitrosation of phenols in smoked bacon.

Knowles, M. E.; Gilbert, J.; McWeeny, D. J. *Nature, UK* 249 (5455) 672-673 (1974) [7 ref. En] [Food Sci. Div., Min. of Agric., Fisheries & Food, Colney Lane, Norwich, NOR 70F, UK]

Bacon samples from traditional smoking and from spray-smoking processes were examined for nitroso- and nitrophenols. Samples were examined raw and fried and after simulated gastric digestion. Both processes resulted in the deposition of phenols (mainly cresols, guaiacols and syringols) in the meat matrix. GC analysis of green bacon showed no significant nitrogen-containing peaks. 6-nitro-m-cresol was found in the raw and fried traditionally-smoked bacon and in the fried, spray-smoked bacon and its cooking volatiles. 6-Nitroguaiacol was found in the spray-smoked bacon volatiles, and 6-nitro-4-methylguaiacol in the volatiles of both bacons. The results indicate that nitrite reacts with a wide variety of smoke phenols in bacon during production, frying, and simulated gastric digestion. CRI

[Production of cooked sausage using nitrite salt.]

Kaevuori, M.; Hill, P.

Suomen Eläinlääkärilehti 80 (3) 116-120, 125 (1974) [6 ref. Fi, en] [Eläinlääketieteellinen Korkeakoulu, Elintarvikehygienian Laitos, Finland]

At the end of 1974, Finnish food laws will no longer permit addition of nitrite solutions to meat products; addition will have to be in the form of the nitrite salt, in conjunction with NaCl (with an upper limit of 0.6%). Tests were therefore carried out to determine a satisfactory method of adding the nitrite salt: by mixing in a meat suspension or by premarinating the meat for 24 h. Both methods gave good results from the viewpoint of organoleptic characteristics, pH and bacterial load. The nitrite content in both cases was reduced by addition of ascorbate, citric acid and δ -gluconolactone. [From En summ.] HBr

[Rapid detection of excessive nitrite contents in meat products by Nitratesmo reagent paper.]

Schnellerfassung überhöhter Nitritgehalte in Fleischwaren mit Hilfe von Nitratesmo-

Reagenzpapier.

Hofmann, K.; Blüchel, E.

Fleischwirtschaft 54 (6) 1083-1084 (1974) [3 ref. De, en] [Bundesanstalt für Fleischforschung, 8650 Kulmbach, Blüch 4, Federal Republic of Germany]

'Nitratesmo' reagent paper for detecting high concn. of NO_2^- in meat products was tested. The yellow dye developed during the reaction is a nitrosamine, so that NO_2^- decomposition products able to form nitrosamines also give positive tests. In tests with experimental sausages, 90 ppm NO_2^- was barely detectable either before or after boiling, but was not detectable at all after ≥ 1 days storage. Weak colour formation produced by 180 ppm NO_2^- (which corresponds to normal use of 3% curing salt) persisted during 14 days storage. Higher illegal concn. of NO_2^- produced a stronger colour, persisting during 14 days storage. Detection is much less sensitive than by Griess's reagent. For quantitative detn., aqueous extract of the dye is measured spectrophotometrically at 390 nm. The colour reagent was stable during 1½ yr of storage at room temp. RM

[Contents of nitrate and nitrite in some Norwegian meat products.]

Nordal, J.; Lund, A.; Dahle, H. K.

Norsk Veterinærtidsskrift 86 (4) 165-169 (1974) [19 ref. No] [Inst. for Neringsmiddelhygiene, Norges Veterinærhøgskole, Norway]

12-12 samples of mutton sausage, boiled ham and cervelas sausage were analysed for contents of potassium nitrate and sodium nitrite. With regard to the potassium nitrate content, 17 of the 40 samples tested had 0-10 ppm and 4 had >60 ppm; max. content was 700 ppm (mutton sausage), but the majority had <40 ppm. With regard to potassium nitrite, 20 of the 43 samples tested had 0.10 ppm and 4 had >60 ppm; max. content was 140 ppm (?) (mutton sausage). When samples of cervelas sausage containing initially 65 ppm sodium nitrite were stored, a decline in the nitrite contents occurred; at room temp. the concn. had dropped to 10 ppm after 1 day and to approx. 4 ppm after 5 days; at 4°C , the decline was steady, reaching 20 ppm after 5 days; and at -20°C , there was a decline to approx. 54 ppm after 2 days, but no further change was observed after 5 days. HBr

[Factors influencing the formation of nitrosamines and their toxic effects.]

Polic, M.

Technologie Mesa 14 (12) 395-396 (1973) [8 ref. En, sh] [Jugoslavenski Inst. za Tehnologiju Mesa, Belgrade, Yugoslavia]

Factors influencing nitrosamine formation (nitrite concn., secondary amine concn., pH, temp., reaction time and presence of protective colloids, e.g. starch) are discussed; the presence of nitrites is necessary for nitrosamine formation in meat products. It is not yet certain whether the residual nitrite concn. permitted in meat products is sufficient to result in nitrosamine formation. STI

52

[Comments on the new meat regulations.] Anmerkungen zur neuen Fleisch-Verordnung. Kreuzer, W.; Ring, C.; Kotter, L. *Fleischerei* 24 (10) 61, 63, 66, 67 (1974) [De] [8 Munich 22, Veterinärstrasse 13, Federal Republic of Germany]

Changes in the regulations for meat and meat products in the Federal Republic of Germany, are critically discussed, with reference to: restrictions on the use of cutting salts in the manufacture of sausage emulsions and similar products; permission for use of calcium citrate for control of coagulation of blood; increases in the range of materials permitted for use in the manufacture of synthetic sausage casings; permission for antioxidant treatment of animal fats; use of talcum powder ($MgSiO_3$) for surface treatment of non-edible casings of air-dried raw surfaces; regulations for smoking of meat products, and the 3,4-benzpyrene concn. in smoked products; restrictions on the use of KNO_3 ; changes in the list of prohibited additives; and changes in labelling regulations. AJDW

53

[Effect of nitrate, nitrite and ascorbic acid on sulphhydryl groups in canned cured meat.] Einfluss von Nitrat, Nitrit und Ascorbinsäure auf den Gehalt an Sulfhydrylgruppen in Pökelfleischkonserven. Susic, M.; Hofmann, K.; Manojlovic, D.; Nikolic, G.

Fleischwirtschaft 54 (6) 1081-1083 (1974) [19 ref. De, en] [Jugoslawisches Inst. für Lebensmitteltech. Novi Sad, Yugoslavia]

The effects of NO_2^- , NO_3^- , ascorbic acid and storage on the thiol content of 60 samples of canned meat products (i) pasteurized at $76^\circ C$, and (ii) 72 samples sterilized at $100-110^\circ C$, were studied. An inverse relationship was found between NO_2^- and thiol content in both types of product. Thiol content ($mol/10^5$ g protein) of 3 kinds of (i) was 6.2-10.3 (mean for all products 6.6-9.8) with highest concn. in samples containing 7 mg $NaNO_2/100$ g, and lowest concn. in samples with 35 mg/100 g; corresponding figures for (ii) were 4.0-7.4 (mean 4.5-6.9). NO_3^- , ascorbic acid and variation in heating time had no effect. During storage, thiol content fell steadily in pasteurized products to 6.2-9.4 $mol/10^5$ g protein after 6 months. In sterilized products, a slight rise was observed between 6 and 12 months storage, probably due to interference of other compounds and a subsequent fall to 4.7-6.8 $mol/10^5$ g after 24 months of storage. RM

Environmental quality and safety. Global aspects of chemistry, toxicology and technology as applied to the environment. Vol. II. [Book]

Coulston, F.; Korte, F. (Editors) xviii + 333pp. ISBN 3 13 498001 0 & ISBN 0 12 227002 9 (1973) [many ref. En, de] Stuttgart, Federal Republic of Germany; G. Thieme Verlag, New York, USA, Academic Press, Inc.

This book discusses the various aspects of the evaluation of safety of environmental chemicals, drugs, physical agents, pesticides and food additives. Chapters include: Some of the opportunities for science in the food industry, by W. B. Murphy (pp. 14-21); Some FAO activities and attitudes concerning pesticides, by E. E. Turtle (pp. 21-24); DDT-chlorophenothene: the situation in the Federal Republic of Germany, by H. P. Tombergs (pp. 24-25); Drinking water and waste water problems, by C. Mendia (pp. 47-52); Inorganic chemicals in the environment - with special reference to the pollution problems in Japan, by M. Goto (pp. 72-77, 7 ref.); pesticide residues in food - the situation today, by H. Egan (pp. 78-87, 47 ref.); Chemicals in the environment; Some aspects of agricultural chemicals, by H. Hurtig (pp. 88-99, 5 ref.); Food additives, by R. Frank (pp. 100-104); Toxic microelements and therapeutics in food of animal origin, by W. Krenzer (pp. 105-109, 66 ref.); Studies on the toxicology of nitrites, by N. Gruener & H. I. Shuval, (pp. 219-229, 15 ref.); [Contd. in following abstr.] GL

55

Food Group Symposium.

United Kingdom, Society of Chemical Industry, Food Group

Journal of the Science of Food and Agriculture 25 (8) 1041-1054 (1974) [42 ref. En]

Interactions between sodium nitrite and foodstuffs [pork, egg, bread, milk, cheese] under gastric conditions, by B. E. Wells, R. Walker & C. L. Walters (pp. 1048-1049, 3 ref.); Long-term studies on some antioxidants in the rat, by D. N. Rudra, J. W. T. Dickerson & R. Walker (pp. 1049-1050, 4 ref.); Toxicity of BHT in life-span studies in rats, by T. J. B. Gray & D. V. Parke (pp. 1050-1051, 5 ref.); Implications of pH in the assay of total folate activity, by J. O. Malin (p. 1051, 5 ref.); The stereochemistry of sweetness, by M. G. Lindley & G. G. Birch (p. 1052); Factors affecting the acceptability of food - food colour, by J. Grant & J. Thomson (pp. 1052-1053); A technique for the trapping of flavour compounds eluted from gas chromatographic columns for organoleptic evaluation (sensory analysis), by R. G. Clark & D. A. Cronin (p. 1053, 1 ref.); and Changes in the microflora during the laboratory preparation of merissa, a beer-like African beverage, by A. P. Williams & M. O. Moss (p. 1054). JA

56

Polarographic determination of the nitrosation products of creatine and creatinine.

Vehsek, J.; Davidek, J.; Klein, S.

Zeitschrift für Lebensmittel-Untersuchung und -Forschung 155 (4) 203-208 (1974) [15 ref. En, de] [Dept. of Food Chem. and Analysis, Inst. of Chem. Tech., Prague, Czechoslovakia]

A polarographic method for simultaneous determination of nitrosation products of creatine (N-nitrososarcosine) and creatinine (creatine-5-oxime, 1-methylhydantoin-5-oxime) in meat is described. 10g of meat is homogenized by grinding with 10% perchloric acid. The homogenate is then made up to 100 ml with perchloric acid and filtered; 20 ml of the filtrate is then neutralized with KOH, held for 30 min at 0°C and filtered. 2 ml of the filtrate + 1 ml methanol are then transferred to a volumetric flask and the vol. made up to 10 ml with 0.1N HCl. The dissolved O₂ is then separated, and the polarographic waves are recorded; the positive wave corresponds to reduction of the two oximes, the negative wave corresponds to reduction of N-nitrososarcosine. Similar polarographic measurements in McIlvaine buffer (pH 12.0) give values for creatine-5-oxime. The concn. of 1-methylhydantoin-5-oxime can then be calculated by difference. NaNO₂ can interfere with measurements in 0.1N HCl; this may be eliminated by addition of methanol, the resulting methyl nitrite being removed by bubbling N₂ through the sample. Detection limit is approx. 15 mg/100 g meat. Analytical error was 1.78% for N-nitrososarcosine, 1.63% for creatine-5-oxime and 1.37% for 1-methylhydantoin-5-oxime. AJDW

57

Technical note: the effect of ultimate pH (pH_u) of pork on some characteristics of vacuum packaged bacon.

Dempster, J. F.

Journal of Food Technology 9 (2) 255-258 (1974) [8 ref. En] [Animal Sci. Div., An Foras Taluntais, Dunsinea, Castleknock, Co. Dublin, Irish Republic]

4 sides of pork of low ultimate pH (<6.0) and 4 sides of high ultimate pH (>6.0) were selected and cured in the same brine. After maturation pH was measured again and a portion of each side sliced. The rashers were packaged in pouches of Saran coated cellulose/polyethylene. Packs were stored at 0°C for 7 days and then transferred to a refrigerator (10° ± 1°C) for 21 days. Bacteriological, organoleptic and chemical analyses were performed at weekly intervals. Results are tabulated for pH, mean % NaCl, log₁₀[nitrite], odour values and log₁₀ bacterial counts. High ultimate pH bacon gave a significantly lower odour score than low ultimate pH bacon but was more susceptible to bacterial spoilage. Low ultimate pH bacon contained more NaCl (6.77-7.02%) than high ultimate pH bacon (6.18-6.84%) but less nitrite, 1.973 compared with 2.315 for high ultimate pH bacon after 7 days refrigerated storage. CRI

58

[Quantitative variations in nitrate and nitrite contents during the salting of meat.]

Fritolli, M.; Cantoni, C.; Merlino, M.

Scienza e Tecnologia degli Alimenti 2 (4) 227-231 (1972) [9 ref. It, en] [Istituto di Ispezione degli Alimenti di Origine Animale, Univ. di Milano, Italy]

Changes in the contents of nitrates and nitrites in 3 different sausage mixes and homogenates of various muscles of bovine, porcine and equine origin during storage at 2-4°C for up to 10 days (mixes), 62 days (bovine muscles), 134 days (porcine) and 350 days (equine) were studied; all the samples contained 150 mg added nitrates or nitrites/kg. The results, given in tabular form, confirmed earlier findings on the partial reduction of nitrites to nitrosomyoglobin and to nitrates. Some practical considerations from the viewpoint of avoiding errors in descriptive labelling are given. HBr

59

Inhibition of spores of *Clostridium* spp. by sodium nitrite.

Roberts, T. A.; Smart, J. L.

Journal of Applied Bacteriology 37 (2) 261-264 (1974) [7 ref. En] [Meat Res. Inst., Langford, Bristol, BS18 7DY, UK]

In an attempt to establish the reasons for microbiological stability in canned cured meat products, a study was made of the inhibition of *Clostridium botulinum* and *Cl. sporogenes* spores by sodium nitrite heated in a laboratory medium (SBCM medium [See *Journal of Food Technology* (1967) 2 377]). Also studied were the effect of prolonged incubation, survival of spores in the presence of the inhibitor and the stability of the unknown inhibitor. Heated sodium nitrite was more inhibitory to the spores than nitrite added as a filter-sterilized solution to the SBCM medium. Most spores remained refractile after inhibition for >3 months and some proved viable when inoculated into fresh nitrite-free medium. The inhibitory activity of heated nitrite medium was not stable indefinitely, growth sometimes occurred on re-inoculation with vegetative cells. It is uncertain whether the inhibitor of *Clostridium* spp. formed by heating in SBCM medium has any relevance to heated cured meat products. JA

60

Rapid formation of carcinogenic N-nitrosamines by interaction of nitrite with fungicides derived from dithiocarbamic acid in vitro under simulated gastric conditions and in vivo in the rat stomach.

Eisenbrand, G.; Ungerer, O.; Preussmann, R. *Food and Cosmetics Toxicology* 12 (2) 229-232 (1974) [12 ref. En] [Inst. für Toxikologie und Chemotherapie am Deutschen

Krebsforschungszentrum, 69 Heidelberg 1, Federal Republic of Germany]

Many agricultural chemicals contain structures that can be N-nitrosated and food may contain residues of such compounds in the presence of nitrite. The formation of the carcinogen dimethylnitrosamine (DMN) from the fungicide ziram (bis-(dimethylthiocarbamate)zinc) in the presence of sodium nitrite was studied. Under the selected conditions, optimum pH for the formation of DMN was 1.5-2.0; more than 1 mg DMN being produced after a 10 min incubation of 10^{-4} moles ziram with 20-fold molar excess of nitrite. Ferbam and DPTD (dipyrrolidylthiuram disulphide) produced DMN and N-nitrosopyrrolidine respectively under the same conditions. It is concluded that fungicides derived from dithiocarbamic acid rapidly form significant amounts of carcinogenic nitrosamines when they come into contact with nitrite under the conditions prevailing in the stomach. Residues of these fungicides, widely used in the cultivation of fruit and leafy vegetables, represent a potential starting material for the formation of carcinogenic nitrosamines when ingested with nitrite. VJG

61

Formation of N-nitrosopyrrolidine from pyrrolidine ring containing compounds at elevated temperatures.

Huxel, E. T.; Scanlan, R. A.; Libbey, L. M. *Journal of Agricultural and Food Chemistry* 22 (4) 698-700 (1974) [9 ref. En] [Dept. of Food Sci. and Tech., Oregon St. Univ., Corvallis, 97331, USA]

The formation of N-nitrosopyrrolidine from various pyrrolidine ring containing compounds and sodium nitrite at elevated temp. was investigated. N-Nitrosopyrrolidine was formed when dry samples of L-proline, glycyl-L-proline, L-prolylglycine, and pyrrolidine were heated with nitrite at 170°C for 2 h and when proline was heated for 2 h with sodium nitrite at 170°C in a pH 6.2 buffer solution. Buffered collagen samples produced N-nitrosopyrrolidine at temp. of 120°C and above. L-Hydroxyproline did not produce N-nitrosopyrrolidine. The identity of N-nitrosopyrrolidine was confirmed in the heated samples by GLC coupled with MS. AS

62

Functions of curing agents in the curing of meat.

Sharma, N.; Mahadevan, T. D. *Indian Food Packer* 27 (6) 25-27 (1973) [13 ref. En] [Div. of Poultry Res., Indian Vet. Res. Inst., Izatnagar, U.P., India]

The use of curing as a means of meat preservation is discussed with reference to the functions of the following ingredients of the curing mixture: NaCl; NaNO₃; NaNO₂; and sugar. The effects of adding ascorbic acid, polyphosphates or monosodium glutamate to the curing mixture are also considered. AA

63

Nitrite in curing - the fate of nitrogen.

Walters, C. L.

IFST Proceedings 6 (3) 106-110 (1973) [En] [British Food Manufacturing Ind. Res. Assoc., Leatherhead, Surrey, UK]

Following a few explanatory details concerning the various haem compounds to be found in muscle, the following aspects of the fate of nitrite in curing are dealt with: factors affecting the disappearance of nitrite in contact with muscle tissue; reactions of nitrite relevant to muscle components and their anticipated products; and observed products of the use of nitrite in curing. JA

64

[Destruction of vitamin A in liver during processing. I. Effect of ascorbic acid on destruction of vitamin A during cooking and mincing.]

Die Zerstörung des Vitamins A der Leber bei ihrer technologischen Verarbeitung. I. Die Wirkung der Ascorbinsäure auf die Zerstörung des Vitamins A während des Kochens und Zerkleinerns der Leber. Hannukainen, E.; Niinivaara, F. P.

Fleischwirtschaft 54 (8) 1363-1366 (1974) [many ref. De, en, fr] [Inst. für Fleischtech., Univ., SF-00710 Helsinki 71, Finland]

The ascorbic acid present in liver (19.3-35.5 mg/100 g) did not correlate with vitamin A losses during cooking (0-16.4%, mean $6.3 \pm 5.1\%$) and mincing (0-13.9%, mean $6.1 \pm 5.7\%$, or total loss during cooking and mincing 0-28.7%, mean $12.4 \pm 8.3\%$). Ascorbic acid losses during cooking were 13.8-29.2%, mean $19.1 \pm 7.0\%$, and during mincing 1.7-14.9%, mean $7.7 \pm 6.5\%$; total loss was 3.6-59.8%, mean $28.2 \pm 17.3\%$. Addition of 0.1% ascorbic acid to cooked liver had little effect, 0.2% ascorbic acid prevented further loss of vitamin A during mincing. Addition of 0.2% NaNO₂ during mincing of cooked liver prevented vitamin A loss but resulted in 52-96% loss of ascorbic acid. [See also following abstr.] RM

65

Inhibition of mouse-liver microsomal enzyme function after oral administration of sodium nitrite.

Friedman, M. A.; Sawyer, D. R.

Food and Cosmetics Toxicology 12 (2) 195-200 (1974) [11 ref. En, fr, de] [Dept. of Pharmacology, Med. Coll. of Virginia, Health Sci. Div., Commonwealth Univ., Richmond, 23298, USA]

The reactivity of sodium nitrite with haem groups has raised the possibility that other relevant haem-containing enzyme systems may be sensitive to nitrite intoxication. The inhibitory effects of sodium nitrite on the mixed-function oxidase of liver microsomes were studied by administering a single oral dose of sodium nitrite at dose levels of 200, 150, 100, 75, 50 and 25 mg/kg. Mice were killed 15, 30, 60, and 90 min after treatment and livers assayed for (i) aminopyrine-demethylase and

(i) aniline hydroxylase activity. Rapid and marked inhibition of (i) and (ii) was noted at 100 mg/kg level. Inhibitory effects (approx. 50%) occurred after 15 min and were still present after 90 min. Responses at 45 min were dose-dependent, no response being observed at 25 mg/kg. Daily oral administration of 25 or 50 mg sodium nitrite/kg for 8 days produced no subacute inhibition of (i) and (ii) activity. VJG

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FAB 48

NITRATES AND NITRITES IN MEAT PRODUCTS

SELECTED FROM VOLUME 7

FOOD SCIENCE AND TECHNOLOGY ABSTRACTS

under the direction of

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H. BROOKES

ASSISTANT EDITOR

1

[Changes in the nitrate and nitrite contents of quick-frozen spinach puree.]

Pauer, B.; Szabo, L.

Hűtőipar 20 (3) 87-91 (1973) [4 ref. Hu, en, ru]

The undesirable components (calcium oxalate, nitrate and nitrite) of raw spinach in 1972 and that of the quick-frozen puree manufactured from it were investigated. Total DM content of spinach was 12.01-12.46%, refractive index 6.9-7.1%, calcium oxalate content 1.48-1.76%, NO_3 305-376 ppm, and NO_2 1.5-3.6 ppm. Data for the quick-frozen product were: 6.79-9.73%, 2.17-3.87%, 1.10-1.37%, 267-387 ppm and 1.88-37.7 ppm. Sand content was 0.0122-0.0271%, residue insoluble in HCl was 0.0018-0.0093%. Above values refer to averages of 165 samples. It was established that the nitrate content is influenced by the conditions of cultivation, and the nitrate content by the conditions and time of transport and processing. By applying the appropriate cultivation conditions and processing technology the level of undesirable components may be kept at the permitted value.

IF

2

The influence of potassium chlorate and potassium nitrate on the growth and carbon dioxide production of certain coliform species in Gouda cheese.

Robertson, N. H.; Dixon, A.; Nowers, J. H.

South African Journal of Dairy Technology 6 (2) 105-111 (1974) [10 ref. En, af] [Stellenbosch-Elsenburg Agric. Coll., Muldersvei, Cape Province, South Africa]

The influence of 0.002% KClO_3 and 0.02% KNO_3 [added to cheese milk containing commercial starter and coliforms] on the growth and CO_2 production of 3 coliform spp. in Gouda cheese was determined. Their influence on cheese quality was also assessed. 2 of the spp. were inhibited by these salts, KClO_3 being more inhibitory than KNO_3 . No relationship was found between the extent of inhibition and CO_2 production or openness of the cheese. In the lightly contaminated [control] cheese, KClO_3 improved the score by 1.1 points; KNO_3 lowered the score by 0.2 points. In heavily contaminated cheeses KNO_3 was the more effective in improving the score, viz. 1.1 points vs. 0.7 for $\text{KCl}/3$. AS

3

Controlled-potential iodometric titration of nitrite. Application to the determination of nitrite in meat products.

Karlsson, R.; Torstensson, L.-G.

Talanta 21 (9) 945-950 (1974) [16 ref. En, de, fr] [Dept. of Analytical Chem., Chem. Center, Univ. of Lund, S-220 07, Lund 7, Sweden]

Details are given of a controlled-potential coulometric method using I as an intermediate, devised for the determination of nitrite. Nitrite is reduced by iodide and the I formed is then reduced coulometrically. In order to establish the best

conditions for the determination of nitrite a series of measurements were performed in which the pH was varied between 0 and 6; the optimum pH was found to be 0.5-1.5. The time of analysis for a determination in the range 0.005-5 mg nitrite was 2-5 min and the error $\pm 0.1\%$. The application of the method to the determination of nitrite in meat products such as pork sausage, ham, German sausage and bacon is detailed. It is concluded that the method is rapid and accurate and is an excellent alternative to the standard spectrophotometric method. AA

4

A new method of curing.

Ranken, M. D.

IFST Proceedings 6 (3) 157-163 (1973) [17 ref. En] [British Food Manufacturing Ind. Res. Assoc., Randalls Road, Leatherhead, Surrey, UK]

Doubts on the toxicity of residual nitrite in cured meats have resulted in UK regulations setting an upper limit of 200 ppm, with prospects of further reduction. The absolute min. requirements of nitrite to produce satisfactory pink colour and flavour, delay spoilage and inhibit pathogens remain uncertain and variable. Investigations at the British Food Manufacturing Industries Research Association are reported, aimed at producing bacon and ham with the single attribute of satisfactory colour and no residual nitrite. Destruction of excess final nitrite by use of additives proved unsatisfactory and possibilities of reducing the initial amount used were studied. The cured colour consists of nitric oxide myoglobin, formed from the nitrite and the (variable) meat myoglobin. In practice an excess of nitrite over theoretical chemical requirements is needed. An immersion technique was developed for experimental curing of pork slices which gave uniform controlled concn. of salt and residual nitrite (≥ 25 ppm).

ELC

5

A new method of curing.

Ranken, M. D.

IFST Proceedings 6 (3) 157-163 (1973) [17 ref. En] [British Food Manufacturing Ind. Res. Assoc., Randalls Road, Leatherhead, Surrey, UK]

[Continued from previous abstr.] Pink colour formation required 20 ppm nitrite, with 50 ppm to ensure a stable colour. Uniform distribution through large pieces presented a major difficulty and limited the reduction of residual nitrite to 50 ppm. Direct curing with nitric oxide in place of nitrite was then tried. Excellent even colour was produced in bacon slices (4 mm), with no nitrite residue, by exposure to 0.1% concn. of nitric oxide in N_2 for 5 min followed by 36 h development. Curing of large pieces, e.g. 10 cm thick, requires 24 h exposure and nitric oxide concn. which may leave residual nitrite. Further studies, e.g. injection methods, are in progress. ELC

6

Use of additives in meat curing.

Gilmour, R. H.

IFST Proceedings 6 (3) 163-167 (1973) [11 ref. En] [Griffith Lab. (UK) Ltd., Cotes Park Farm, Somercotes, Derby, DE5 4MM, UK]

The chemical basis of colour development during nitrite curing is discussed, together with the advantages of ascorbate additions to the curing solution in shortening the curing time for colour development, reducing colour fading during storage and reducing residual nitrite. Manufacture of frankfurters necessitates a halt to production to allow colour development at the final stage before smoking-cooking (250°F for 14 min). Colour development is accelerated at low pH values combined with ascorbate but most acids prevent efficient emulsification; however, additions of glucono-delta-lactone (which converts to gluconic acid) aided colour development without excessive weakening of the emulsion and gave low residual nitrite values. Sodium acid pyrophosphate (11.5 oz/100 lb meat) gave slightly slower colour development, but a more stable emulsion. Phosphates also aid yield control and reduce wt. losses in cooking, for which sodium tripolyphosphate is commonly used.

ELC

7

Use of additives in meat curing.

Gilmour, R. H.

IFST Proceedings 6 (3) 163-167 (1973) [11 ref. En] [Griffith Lab. (UK) Ltd., Cotes Park Farm, Somercotes, Derby, DE5 4MM, UK]

[Continued from previous abstr.] Alkaline phosphates are generally preferable, especially in combination with NaOH, and are particularly useful when yield is more important than rapid colour development. (e.g. in canned hams). Salt contributes flavour and reduces microbial growth, while seasonings contribute flavour only. Smoking contributes flavour and is bacteriostatic, but smoke extracts are satisfactory if flavour is the only requirement. Problems of nitrite residuals and curing of large pieces of meat are mentioned.

ELC

8

[Studies on the curing of meat products. III. Residual NO₃ and NO₂ levels in meat products.]

Mori, K.; Akahane, Y.; Nakao, K.; Kawano, K. *Bulletin of the Japanese Society of Scientific Fisheries [Nihon Suisan Gakkai-shi]* 39 (12) 1285-1291 (1973) [9 ref. Ja, en] [Nippon Shinyaku Co. Ltd., Food Res. Inst., Kyoto, Japan]

Meat colour development and residual nitrate and nitrite levels were studied in cured meats processed with added nitrate, nitrite or raw spices containing nitrate in the presence of reducing agents such as ascorbic acid and cysteine. Residual nitrite decreased considerably and there was good colour development in the presence of reducing

agents. Low nitrate levels were detected in meat products processed without the addition of nitrate but further experiments are necessary to determine the source of this nitrate. Raw spices were found to contain high levels of nitrate; cured meat colour developed well in the presence of ascorbic acid when raw spices, such as raw celery juice, were added. [From En summ.]

AA

9

[Examination of the effective strains for the curing process of meat products. III. Nitrate and nitrite reduction of the strains isolated from pickles.]

Akashi, A.

Japanese Journal of Dairy Science [Rakuno Kagaku no Kenkyu] 23 (2) A57-A64 (1974) [3 ref. Ja, en] [Lab. of Chem. and Tech. of Animal Products, Kyushu Univ., Fukuoka, Japan]

The nitrite and nitrate reduction activities of 16 strains of microorganisms (including yeasts, *Micrococcus* spp., *Achromobacter* spp., *Pediococcus* spp., *Pseudomonas* spp.) isolated from 7 meat-curing brines were evaluated. The isolates were incubated in media containing KNO₃, for 5 days at 10 or 30° to evaluate nitrate reduction, or in a medium containing KNO₂ for 5 days at 5 or 10°C to evaluate reduction. Reductase activities were higher at 10°C than at 5 or 30°C; nitrite reductase activity decreased with increasing nitrite concn. Of the 16 strains tested, 2 yeast strains, 1 *Achromobacter* strain and 1 *Pediococcus* strain exhibited high nitrite reductase activities. [From En summ.]

AJDW

10

Characteristics of cured ham as influenced by levels of sodium nitrite and sodium ascorbate.

Brown, C. L.; Hedrick, H. B.; Bailey, M. E.

Journal of Food Science 39 (5) 977-979 (1974) [23 ref. En] [Dept. of Food Sci. & Nutr., Univ. of Missouri, Columbia, 65201, USA]

Hams cured with varied levels of NaNO₂ and sodium ascorbate were evaluated for flavour and texture desirability by a sensory panel and residual nitrite was determined. Hams cured with 91 and 182 ppm nitrite were similar in flavour but those cured nitrite were scored as having more intense cured meat flavour than non-nitrite cured hams. The concn. of nitrite injected into hams was directly related to residual nitrite in cured hams. Hams treated with sodium ascorbate had lower residual nitrite than non-ascorbate-treated hams. Higher levels of ascorbate resulted in increased nitrite depletion. IFT

11

Cured ham properties as affected by nitrate and nitrite and fresh pork quality

Kemp, J. D.; Fox, J. D.; Moody, W. G.

Journal of Food Science 39 (5) 972-976 (1974) [14 ref. En] [Dept. of Animal Sci., Univ. of Kentucky, Lexington, 40506, USA]

Normal and PSE (pale, soft, exudative) hams were dry cured with salt and sugar only, salt, sugar and KNO_3 or salt, sugar and NaNO_2 . PSE hams lost more wt. during curing and ageing but were generally more tender than normal hams although normal hams were more flavourful. Hams cured with nitrate or nitrite had more desirable colour and general appearance scores than controls. Aroma was similar for all groups. Flavour was more desirable in the nitrate and nitrite groups than in controls, with no difference between nitrate and nitrite groups. Saltiness was not affected by either quality or cure. In general, dry-cured hams cured with a curing mixture containing either nitrate or nitrite were superior to those cured with salt and sugar only, although many of the latter were highly acceptable. IFT

12

Inhibition of morpholine nitrosation by some phenolic wood smoke components.

Issenberg, P.; Virk, M.

Abstracts of Papers, American Chemical Society 168 AGFD 53 (1974) [En] [Eppley Inst. for Res. in Cancer, Univ. of Nebraska, Med. Center, Omaha, Nebraska 68105, USA]

Human exposure to carcinogenic N-nitroso compounds is influenced by amounts of precursor amines and nitrosating agents present in foods and other parts of the environment and by catalysts and inhibitors which may occur naturally or be added. Any factor which influences reaction rates will modify yields of N-nitroso compounds produced in foods or by intragastric reaction. Some phenolic compounds, previously identified in hardwood sawdust smoke and smoked foods, may be nitrosated and compete with amines for available nitrite. Phenol structure is an important factor in determining rate constants for C-nitrosation reactions. Ability of some phenolic components of smoked foods to inhibit nitrosation of morpholine was investigated. Model reaction mixture (pH 3.0) contained 0.01M morpholine, 0.02M sodium nitrite, and 0.02M phenol: 0.02M ascorbic acid was employed as reference inhibitor. Reaction time was 90 min. Under these conditions, nitrosomorpholine yield was 30% in uninhibited mixture. Phenol, 2-methoxyphenol, 2-methoxy-4-methylphenol, 2,6-dimethoxyphenol, and ascorbic acid provided 15%, 71%, 81%, 93%, and 96% inhibition, respectively. Since many nitrite cured foods are smoked, influence of smoke components on nitroso compound formation must be thoroughly evaluated. AS

13

Health laws and regulations - Philippines.

World Health Organization

International Digest of Health Legislation 24 (4) 884-897 (1973) [En] [Geneva, Switzerland]

A selection of Philippine health laws and regulations is presented including the following which relate to food hygiene: Bureau of Standards, Department of Commerce and Industry, Standards Administrative Order No. 65 of 1969, Philippines Trade Standard specification for ready-to-cook

poultry (dated 12 Sept., 1969); Standards Administrative Order No. 76 of 1970, Philippines Trade Standard specification for live fresh chilled and frozen shrimp (date 3 July, 1970); Office of the Secretary, Department of Health, Administrative Order No 134 of 1970, Regulation prescribing the standard of identity and quality of vinegar (dated 25 Sept., 1970); Administrative Order No. 131 of 1970, regulations prescribing the standards of identity and quality of milk and milk products (dated 20 Oct., 1970); and Administrative Order No. 154 of 1971, Regulation B-4: definition of standards of identity for sausages which prescribes that the amount of K or Na salts, calculated as sodium nitrate, must not exceed 500 mg/kg or calculated as sodium nitrite must not exceed 200 mg/kg of total net content of the sausage. VJG

14

The determination of total non-volatile nitrosamines in microgram amounts.

In "Proceedings of the International Symposium on Nitrite in Meat Products". [Conference proceedings]

Walters, C. L.; Fueggle, D. G.; Lunt, T. G. (Netherlands, Central Institute for Nutrition & Food Research TNO)

pp. 53-58 ISBN 90-220-0463-5 (1974) [7 ref. En] Wageningen, Netherlands [Biochem. Section, BFMIRA, Leatherhead, Surrey, UK]

A selective method for determination of total non-volatile nitrosamines and nitrosamides in foods is described. Food samples are dried (preferably freeze-dried) and suspended in approx. 200 ml dry methylene chloride; dry N_2 is then bubbled through the suspension to displace damp air. 5 ml of a 25% solution of thionyl chloride is then added to denitrosate the nitrosamines or nitrosamides; the resulting product (presumably nitrosyl chloride) is then volatilized by a stream of N_2 and collected in a trap containing 5 ml of 100% (w/v) aqueous NaOH solution. To determine the nitrite formed in the trap, 1 ml of sulphanilamide solution (5% in conc. HCl, diluted with 3 vol. of water) is added, followed by 1 ml conc. HCl to lower the pH for diazotization. Colour development occurs following addition of 1.0 ml N-(1-naphthyl) ethylenediamine dihydrochloride (0.1% aqueous solution); nitrite is determined by optical density measurements at 540 nm. The nitrite yield from nitrosamines generally approximated to that achieved by denitrosation with hydrobromic acid in glacial acetic acid. Of other organic N compounds tested, none gave a significant nitrite yield after treatment with thionyl chloride. In the absence of water, little or no interference from inorganic nitrite occurs. Advantages claimed for the method include specificity, absence of an extraction step, and high sensitivity. AJDW

15

Determination of volatile amines and amine oxides in food products.

In "Proceedings of the International Symposium on Nitrite in Meat Products". [Conference proceedings]

Ruiter, A. (Netherlands, Central Institute for

Nutrition & Food Research TNO)
pp. 37-42 ISBN 90-220-0463-5 (1974) [8 ref. En]
Wageningen, Netherlands [Inst. for Fishery
Products TNO, IJmuiden, Netherlands]

A method for determination of volatile dialkyl and trialkylamines and amine oxides in foods is described. Samples are extracted with trichloroacetic acid solution and the extract is filtered. Amines are then separated by steam distillation, collected in HCl, and concentrated by evaporation. The conc. distillate is then adjusted to pH 10-11, and separated by GLC on Carbowax 400 + polyethylene imine. Trimethylamine and dimethylamine may be determined at concn. <1 mg/kg; for max. recovery of dimethylamine during steam distillation, it is necessary to add ethylamine as a distillation aid. Amine oxides may be determined by the above method after initial reduction to the corresponding amine by reaction with TiCl₃. Values for the concn. of trimethylamine, dimethylamine, trimethylamine oxide and total volatile bases in tomato juice, orange juice, Gouda cheese, bananas, minced meat (pork + beef, 1:1), canned mackerel, canned herrings, Maatjes herring, fresh cod, cooked cod and fried whiting are given. The risk of formation of nitrosamines in fish products is briefly discussed. AJDW

16

Determination of volatile nitrosamines: a review. In "Proceedings of the International Symposium on Nitrite in Meat Products". [Conference proceedings]
Eisenbrand, G. (Netherlands, Central Institute for Nutrition & Food Research TNO)
pp. 45-52 ISBN 90-220-0463-5 (1974) [45 ref. En] Wageningen, Netherlands [Inst. für Toxikologie und Chemotherapie, Deutsches Krebsforschungszentrum, Postfach 449, D6900, Heidelberg, Federal Republic of Germany]

Various aspects of the analysis of volatile N-nitrosamines in foods are discussed, including: isolation (by solvent-extraction or distillation methods); further purification (by TLC or column chromatography); and methods of detection and estimation (direct determination of intact nitrosamines, and methods based on formation and determination of derivatives.) AJDW

17

Toxicity of nitrite and N-nitroso compounds. (In "Proceedings of the International Symposium on Nitrite in Meat Products".)
Preussmann, R. (Netherlands, Central Institute for Nutrition & Food Research TNO)
pp. 217-225 ISBN 90-220-0463-5 (1974) [29 ref. En] Wageningen, Netherlands [Inst. für Toxikologie und Chemotherapie, Deutsches Krebsforschungszentrum, Postfach 449, D 6900, Heidelberg, Federal Republic of Germany]

The chronic and acute toxicity of dietary nitrate, nitrite and N-nitroso compounds is discussed, with reference to: methaemoglobinaemia as a result of

excessive levels of nitrate or nitrite in the diet; the absence of carcinogenic or teratogenic effects of dietary nitrate or nitrite; the acute toxicity and carcinogenicity of nitrosamines and nitrosamides; the relation of structure to carcinogenic activity of symmetrical, unsymmetrical and cyclic nitrosamines; problems of estimation of no-effect doses of N-nitroso compounds; and synergistic carcinogenic effects of nitrosamines and other carcinogens. AJDW

18

Philosophy of 'no effect level' for chemical carcinogens. (In "Proceedings of the International Symposium on Nitrite in Meat Products".)
Kroes, R.; Esch, G. J. van; Weiss, J. W. (Netherlands, Central Institute for Nutrition & Food Research TNO)

pp. 227-240 ISBN 90-220-0463-5 (1974) [many ref. En] Wageningen, Netherlands [Nat. Inst. of Public Health, PO Box 1, Bilthoven, Netherlands]

Problems of determination of tolerance levels for chemical carcinogens are discussed, with special reference to legislation for food additives. Aspects considered include: factors influencing carcinogenicity (inhibition, hormonal factors, synergism, co-carcinogenesis); differences between powerful and weak carcinogens; problems of evaluation of the dose-response relationship; possible reversible effects of carcinogens; epidemiological studies in man; increases in the sensitivity of analytical methods and consequent decreases in the detectable residue concn.; problems of definition of carcinogens; and establishment of tolerances on the basis of the min. measured cancer-producing level, safety factors, and available epidemiological data. AJDW

19

[Studies on nitrate and nitrite in horticultural products. IV. Change in nitrate content of celery during storage.]

Hata, A.; Minamide, T.; Ogata, K.

Journal of Food Science and Technology [Nihon Shokuhin Kogyo Gakkai-shi] 20 (9) 421-425 (1973) [14 ref. Ja, en] [Fac. of the Sci. of Living, Kyoto Prefectural Univ., Sakyo-ku, Kyoto, Japan]

A study was made of the distribution of nitrate in green and yellow celery and of the change in the nitrate content of celery under various storage conditions. Nitrate concn. in petioles of green celery was greater than in those of yellow celery. Nitrate content was smaller in the inner petioles than in the outer petioles, greater in the upper petioles near the first node than in the centre, and also greater in the vascular bundle than in parenchymatous tissue. Celery was packed in perforated polyethylene bags and stored at 1, 6 and 20°C. Nitrate content of petioles gradually decreased during storage. The change in nitrate content was similar during storage in controlled atmosphere and in air. Nitrite was not detected in the petioles during storage. [See FSTA (1972) 4 9J1465 for part III.] AS

20

Evaluation of an anion exchange treatment as a method to reduce the nitrate content in whey.

Jönsson, H.

Milchwissenschaft 29 (4) 210-214 (1974) [2 ref. En, de, fr] [Swedish Dairies Association, Central Lab., Malmö, Sweden]

A simple method, performed in both laboratory and on pilot plant scale, to reduce the nitrate content in whey involves passing the whey through a strong base anion exchange resin (e.g. Amberlite IRA-900). A flow rate of 0.50 resin bed vol. (rbv)/min gave only a 10% reduction in nitrate capacity compared with a rate of 0.25 rbv/min. Nitrate capacity increased progressively as whey temp. decreased from 50 to 0°C and as Cl⁻ content in whey decreased from 0.3 to 0.1%. Such a system could easily remove 95% of the nitrate in whey. The method is discussed from an economical point of view, with the importance of regeneration of the resin and reuse of the regeneration solution being emphasized. DMK

21

[Contents of nitrates and nitrites in cheeses.]

Lemieszek-Chodorowska, K.; Lenkiewicz, Z.; Micewicz, B.; Bialek, K.; Bonalska, E.; Brynska, E.; Chomicka, S.; Czupajlo, N.; Diehl, K.; Dolmierska, K.; Jacewicz, B.; Janczewski, K.; Kossakiewicz-Mrowka, M.; Kownacka, R.; Kula, H.; Lewczak, M.; Pikiel, A.; Rosochowicz, R.; Rymaszewska, R.; Sowa, J.; Schulz, L.; Tomys, W.; Weyna, W.; Wierzbinska, B.; Witusik, M.; Wojcieszek, J.; Zacharko, K.

Roczniki Panstwowego Zakladu Higieny 25 (3) 295-302 (1974) [16 ref. Pl, ru, en] [Panstwowy Zaklad Higieny, Warsaw, Poland]

This was a collaborative study of the State Institute of Hygiene in Warsaw and public health laboratories in 13 Polish provinces and 2 towns. Values determined in 1972 for 9 varieties of cheese and in 1973 for 11 varieties are tabulated in content ranges, and a cumulative table for 10-182 samples of 12 varieties of hard ripened cheese tested in both yr is included. The overall distribution of nitrate (KNO₃) contents in 1281 samples was (mg/kg): ≤5.0, 21.6%; >5.0-20.0, 44.9%; >20.0-50.0, 23.1%; >50.0-100.0, 9.4%; and >100.0, 1.0%. Corresponding values for nitrite (KNO₂) were: ≤1.0, 50.3%; >1.0-5.0, 47.5%; >5.0-10.0, 1.9%; and >10.0, 0.3%. The colorimetric method with sulphanilic acid and α-naphthylamine was used. SKK

22

Fate of added nitrite. In "Proceedings of the International Symposium on Nitrite in Meat Products". [Conference proceedings]

Sebranek, J. G.; Cassens, R. G.; Hoekstra, W. G. (Netherlands, Central Institute for Nutrition & Food Research TNO)

pp. 139-148 ISBN 90-220-0463-5 (1974) [20 ref. En] Wageningen, Netherlands [Univ. of Wisconsin, Madison, Wisconsin 53706, USA]

The stable isotope of N was used to study the fate and distribution of nitrite in a cured meat product (luncheon meat). The meat product was fractionated into water-soluble, salt-soluble (protein) and insoluble forms in order to conduct quantitative analysis for ¹⁵N as a function of storage time and processing temp. Residual nitrite, determined 2 days after processing, accounted for less than half the label added in frozen samples and samples processed at 71°C, and the amount of label as nitrite decreased during storage. Samples processed at 107°C were initially very low in nitrite as compared to samples from other heat treatments. As residual nitrite decreased, the amount of nitrite found in the non-nitrite water-soluble fraction and in the protein fraction increased. About 5% of the label was lost as a gas during processing, and 9-12% was present in the pigment fraction. Total recovery of the label was 72-86%. AS

23

Nitrite and the flavour of cured meat. I. In

"Proceedings of the International Symposium on Nitrite in Meat Products". [Conference proceedings]

Mottram, D. S.; Rhodes, D. N. (Netherlands, Central Institute for Nutrition & Food Research TNO)

pp. 161-171 ISBN 90-220-0463-5 (1974) [17 ref. En] Wageningen, Netherlands [ARC Meat Res. Inst., Langford, Bristol BS18 7DY, UK]

The effect of varying the concn. of NaNO₂ used in curing pork upon the flavour of bacon has been investigated. A taste panel was used to identify the various flavour characteristics and to examine products cured under different conditions. As the nitrite concn. was increased from zero to 1000 mg/kg an almost linear increase in the intensity of bacon flavour was found but above 1500 mg/kg further increase in flavour was small. Salt was shown to make a major contribution to bacon flavour but NaNO₂ has no detectable taste at concn. similar to those found in bacon. The differentiation between salt pork and bacon in blind comparisons by flavour or odour was remarkably uncertain. Volatile odorous compounds, isolated from pork and bacon, were analysed by gas chromatography and gas chromatography-mass spectrometry; no compound directly responsible for bacon flavour was isolated. AS

24

Nitrite and the flavour of cured meat. II. In

"Proceedings of the International Symposium on Nitrite in Meat Products". [Conference proceedings]

Wasserman, A. E. (Netherlands, Central Institute for Nutrition & Food Research TNO)

pp. 173-178 ISBN 90-220-0463-5 (1974) [17 ref. En] Wageningen, Netherlands [E. Regional Res. Center, Agric. Res. Service, USDA, Philadelphia, Pennsylvania 19118, USA]

The role of nitrite in development of the flavour of cured meat is discussed, on the basis of literature data. Aspects considered include sensory

differentiation of products cured with or without nitrite; interaction between effects curing and smoking on flavour; nitrite concn. required for acceptable 'cured' flavour; studies on flavour and aroma compounds in cured products; and the possible significance of reactions of nitrite with various meat constituents. AJDW

25

Minimum nitrite concentrations for inhibition of clostridia in cooked meat products. In "Proceedings of the International Symposium on Nitrite in Meat Products". [Conference proceedings]
Grever, A. B. G. (Netherlands, Central Institute for Nutrition & Food Research TNO)
pp. 103-109 ISBN 90-220-0463-5 (1974) [11 ref. En] Wageningen, Netherlands [Central Inst. for Nutr. and Food Res. TNO, Utrechtseweg 48, Zeist, Netherlands]

Laboratory- and factory-prepared cooked sausage and liver sausage emulsions (brine percentage 3.5, nitrite concn. 0-200 mg/kg) were packaged in 76 × 35 mm cans (with or without inoculation with clostridia or various spore-bearing materials) and pasteurized to a core temp. of 80°C for 10 min. The pasteurized cans were then stored for 1, 3 or 5 wk at 24°C, after which they were tested for residual nitrite content and growth of spore-forming bacteria. Similar studies were conducted on luncheon meat and liver paste emulsions (containing 100 or 200 mg nitrite/kg) inoculated with spore counts of 100 or 500/g, -canned, and heated at 95 or 105°C with F_0 values of 0.05 or 0.5 respectively. Growth of spore-forming bacteria was evaluated after incubation for 5 wk at 30°C. Detailed tables and diagrams of results are given. The studies on pasteurized emulsions showed that a nitrite concn. of 200 mg/kg and pH ≤ 6.2 is necessary to guarantee complete prevention of growth of clostridia. The studies on sterilized samples showed incomplete inhibition of clostridia in samples heated to an F_0 value of 0.05, even in the presence of 200 mg/kg nitrite. No growth of clostridia occurred in samples heated to a F_0 value of 0.5. Bacilli were less nitrite-sensitive than clostridia. AJDW

26

Inhibition of bacterial growth in model systems in relation to the stability and safety of cured meats. In "Proceedings of the International Symposium on Nitrite in Meat Products". [Conference proceedings]
Roberts, T. A. (Netherlands, Central Institute for Nutrition & Food Research TNO)
pp. 91-101 ISBN 90-220-0463-5 (1974) [9 ref. En] Wageningen, Netherlands [ARC Meat Res. Inst., Langford, Bristol, BS18 7DY, UK]

The interaction of factors (pH, temp., nitrates, nitrites, NaCl) influencing bacterial growth is discussed on the basis of literature data, with special reference to inhibition of *Clostridium botulinum* by nitrite. Methods for evaluation of inhibitory activity of curing salts are briefly discussed, with reference to effects of media,

selection of strains of bacteria to be tested, and use of growth-no growth tests, viable counts by the MPN method, and counts of viable bacteria in agar media. AJDW

27

The microbiological effects of nitrite. In "Proceedings of the International Symposium on Nitrite in Meat Products". [Conference proceedings]
Ingram, M. (Netherlands, Central Institute for Nutrition & Food Research TNO)
pp. 63-74 ISBN 90-220-0463-5 (1974) [42 ref. En] Wageningen, Netherlands [ARC Meat Res. Inst., Langford, Bristol, BS18 7DY, UK]

The inhibition of microorganisms by nitrite is discussed on the basis of literature data, with special reference to its significance for the curing of meat products. Aspects covered include: chemical and biochemical properties of nitrite; antibacterial effects in heated and unheated systems; effects of temp., NaCl, pH, nitrate and degree of initial microbiological contamination on the antibacterial activity of nitrite; possible mechanisms for the inhibitory activity of nitrite; studies on formation of inhibitory substances from nitrite in culture media and in meat; inoculated pack experiments; and the importance of nitrite for control of *Clostridium botulinum* in cured meat products. AJDW

28

About the mechanism of nitrite loss during storage of cooked meat products. In "Proceedings of the International Symposium on Nitrite in Meat Products". [Conference proceedings]
Olsman, W. J. (Netherlands, Central Institute for Nutrition & Food Research TNO)
pp. 129-137 ISBN 90-220-0463-5 (1974) [15 ref. En] Wageningen, Netherlands [Central Inst. for Nutr. and Food Res. TNO, Utrechtseweg 48, Zeist, Netherlands]

The effects of pH, temperature and addition of an alkylating reagent and ethylenediamine tetraacetate (EDTA) on the rate of loss of nitrite are discussed. The heat of activation of the depletion process is 13 to 14 kcal per mol of nitrite. It is suggested that the small amount of endogenous ascorbic acid in meat plays a key role in the mechanism of the nitrite depletion by acting as an electron carrier in the reduction of nitrite by the sulphhydryl group of the meat proteins. The pH dependence and the effect of alkylation can be explained on the basis of such a mechanism. AS

29

Inhibitors in cooked meat products. In "Proceedings of the International Symposium on Nitrite in Meat Products". [Conference proceedings]
Roon, P. S. van (Netherlands, Central Institute for Nutrition & Food Research TNO)
pp. 117-124 ISBN 90-220-0463-5 (1974) [16 ref. En] Wageningen, Netherlands [Inst. of Food

Hygiene, Dept. of Meat Tech., Fac. of Vet. Sci., Univ. of Utrecht, Biltstraat 172, Netherlands]

The possible formation of inhibitory iron-nitrosyl coordination complexes in canned cured meat products is discussed, with reference to studies on inhibition of clostridia by Black Roussin salt (BRS) and cysteyle-nitrosyl complexes formed by reaction of cysteine and FeSO_4 with NaNO_2 or NO. The results showed that both BRS and the cysteyle-nitrosyl-Fe coordination complex inhibited growth of clostridia. A tentative method (based on extraction with methanol, purification on an Al_2O_3 column and determination by spectrophotometry at 350 nm) was developed; recovery from luncheon meat containing added BRS was 47%. No BRS was detected in samples of normal luncheon meat or luncheon meat containing added FeSO_4 and/or cysteine. Possible reasons for its absence are discussed. The likelihood of formation of cysteyle-nitrosyl-Fe coordination complexes in canned cured meat products is briefly discussed, with reference to the absence of a detectable Perigo effect in heated cured meat products. AJDW

30

Low-molecular meat fractions active in nitrite reduction. In "Proceedings of the International Symposium on Nitrite in Meat Products". [Conference proceedings] Tinbergen, B. J. (Netherlands, Central Institute for Nutrition & Food Research TNO) pp. 29-36 ISBN 90-220-0463-5 (1974) [10 ref. En] [Central Inst. for Nutr. and Food Res. TNO, Utrechtseweg 48, Zeist, Netherlands]

Buffered mixtures of NaNO_2 and low-molecular water-soluble fractions from minced beef muscle were anaerobically heated and stored at 18°C. Subsequently, the free nitrite content was examined at regular intervals. The formation of nitrosomyoglobin was studied in vitro to screen the low-molecular fractions for their ability to reduce nitrite in the presence of ferric metmyoglobin. The fractions strongly reduced the nitrite content in the heated mixtures during storage at 18°C. The activity was pH-dependent. The observed ability of the low-molecular fraction to reduce nitrite to NO to form nitrosomyoglobin under anaerobic conditions was found to be proportional to the concn. of the fraction. It was found that an amino acid or a lower peptide (probably with an SH group) as well as a non-amino acid could be involved in the nitrite reduction. AS

31

Stability of red food colours in the presence of nitrite in canned pork luncheon meat. Knowles, M. E.; Gilbert, J.; McWeeny, D. J. *Journal of the Science of Food and Agriculture* 25 (10) 1239-1248 (1974) [22 ref. En] [Food Sci. Div., Min. of Agric., Fisheries & Food, Colney Lane, Norwich, NOR 7OF, UK]

The stability of 9 red food colours in pork luncheon meat products in the absence and presence of nitrite was investigated. The extracted dyes were examined by visible and UV

spectrophotometry and paper chromatography for changes due to processing and to the presence of nitrite. All the colours were destroyed to some extent but with nitrite more of the food colour survived. Subsidiary dye components and colourless fluorescent products were formed as a result of heat processing and in certain cases additional products were observed in the presence of nitrite. AS

32

The inhibition of Clostridium botulinum by nitrite and sodium chloride. In "Proceedings of the International Symposium on Nitrite in Meat Products". [Conference proceedings] Baird-Parker, A. C.; Baillie, M. A. H. (Netherlands, Central Institute for Nutrition & Food Research TNO) pp. 77-90 ISBN 90-220-0463-5 (1974) [14 ref. En] Wageningen, Netherlands [Unilever Res. Lab., Colworth/Welwyn, Colworth House, Sharnbrook, Bedford, UK]

Studies on inhibition of a wide range of toxigenic types of Clostridium botulinum by NaNO_2 and/or NaCl are discussed. Factors studies included NaNO_2 concn. (50, 100, 150 or 200 ppm); pH (5.5, 6.0, 6.5, 7.0); NaCl concn. (1.5, 3.0, 4.5, 6.0% w/v); incubation temp. (15, 20, 25 or 30°C); incubation time (≤ 28 days, or ≤ 56 days for samples incubated at 15°C); and medium (modified reinforced clostridial medium or Pork Macerate Broth). Tables of values are given showing the extent of growth of C. botulinum in the various samples. The results are discussed in detail. It was observed that: strains differed markedly in their resistance to NaCl and NaNO_2 , type A and proteolytic type B and F strains being more resistant than type E and non-proteolytic type B and F strains; inhibitory activity decreased with increasing incubation temp.; NaCl and NaNO_2 exhibit a synergistic inhibitory activity; L-ascorbic acid increased the inhibitory activity of nitrite in Modified Reinforced Clostridial Medium, but not in Pork Macerate Broth. Preliminary experiments on laboratory-cured bacon, vacuum-packaged and stored at 25°C showed that nitrite-free bacon supported growth and toxin production by C. botulinum; 100-200 mg nitrite/kg bacon effectively inhibited C. botulinum. Addition of 0.1% ascorbic acid had no effect on the inhibitory activity of nitrite in bacon. AJDW

33

Determination of free and bound nitrite. In "Proceedings of the International Symposium on Nitrite in Meat Products". [Conference proceedings] Mirna, A. (Netherlands, Central Institute for Nutrition & Food Research TNO) pp. 21-28 ISBN 90-220-0463-5 (1974) [16 ref. En] Wageningen, Netherlands [Fed. Inst. for Meat Res., Dept. for Chem. and Physics, Kulmbach-Blaich, Federal Republic of Germany]

Methods for determination of free and bound nitrite in meat products are briefly discussed. Various nitrosated compounds were checked for

cleavage of the nitrosyl group by Hg^{2+} in aqueous ethanol; results showed that this procedure is not specific for nitrosothiols. Nitroso compounds differed markedly in their extent of cleavage by Hg^{2+} ; the reaction products of creatinine and nitrite (creatinine-5-oxime and 1-methyldantion-5-oxime) were not split by Hg^{2+} . The effect of extraction conditions (solvent, temp., pH) on determination of nitrite and nitrosomyoglobin in frankfurters and dry sausages were investigated. At low temp., extraction with water gave lower nitrite concn. than extraction with 80% acetone; at higher temp., this difference was eliminated. Recovery of added nitrate decreased and nitrosomyoglobin concn. increased with increasing extraction temp. Extraction under alkaline conditions decreased nitrosomyoglobin concn. but increased recovery of added nitrite. Studies were conducted on the influence of curing pH on free and bound nitrite concn. in sausages and in isolated myofibrils. Results showed that only small amounts of bound nitrite were formed at pH values ≥ 5.8 . AJDW

34

Formation of curing pigments by chemical, biochemical or enzymatic reactions. In "Proceedings of the International Symposium on Nitrite in Meat Products". [Conference proceedings]

Möhler, K. (Netherlands, Central Institute for Nutrition & Food Research TNO)
pp. 13-18 ISBN 90-220-0463-5 (1974) [21 ref. En] Wageningen, Netherlands [Tech. Univ., Munich, 805 Weihenstephan bei Freising, Federal Republic of Germany]

Chemical, biochemical and microbiological reactions in the formation of the curing pigments nitrosomyoglobin and nitrosohaemoglobin are discussed. All systems are derived from metmyoglobin, which is the first product formed in the chain of reaction. It is reduced chemically by SH groups, biochemically by the coenzymes NADH, FMN and FAD, or enzymically by a NADH-dependent dehydrogenase in the presence of ferrocyclochrome C. Under similar or identical conditions, nitrite is reduced to nitric oxide which reacts with the myoglobin or haemoglobin. AS

35

Perigo effect in pork. In "Proceedings of the International Symposium on Nitrite in Meat Products". [Conference proceedings]

Pivnick, H.; Chang, P.-C. (Netherlands, Central Institute for Nutrition & Food Research TNO)
pp. 111-116 ISBN 90-220-0463-5 (1974) [13 ref. En] Wageningen, Netherlands [Food Res. Lab., Food Directorate, Health Protection Branch, Health and Welfare Canada, Ottawa, Canada]

An inhibitor against Clostridium botulinum was formed when canned pork luncheon meat was processed to $F_0 = 0.4$. The meat was manufactured with 0-300 mg/kg of NaNO_2 and all of it was held at 35°C after processing until the highest concn. of

nitrite declined to less than 2 mg/kg. Meat in cans was then inoculated with spores of Cl. botulinum that had survived a heat treatment of $F_0 = 0.4$ in a solution of raw meat juice, 4.5% salt and 150 mg/kg of NaNO_2 . The inhibitory effect could be demonstrated by an increase in time required for inoculated cans to swell and by the number of spores required to initiate growth and cause swelling. However, the inhibitory effect was relatively small; meat made with 3.8% salt in the water phase and 200 mg/kg of nitrite inhibited 3.3 log₁₀ of spores (3.3 units of inhibition). Salt contributed 1.86 units and the inhibitor formed from nitrite contributed 1.43 units. AS

36

Some compounds influencing colour formation. In "Proceedings of the International Symposium on Nitrite in Meat Products". [Conference proceedings]

Ando, N. (Netherlands, Central Institute for Nutrition & Food Research TNO)
pp. 149-160 ISBN 90-220-0463-5 (1974) [34 ref. En] Wageningen, Netherlands [Lab. of Chem. and Tech. of Animal Products, Fac. of Agric., Kyushu Univ., Fukuoka, Japan]

The effects of food additives (glutamate, succinate, nicotinic acid, nicotinamide) and metal ions (Mg^{2+} , Ca^{2+} , Zn^{2+} , Fe^{3+} , Fe^{2+}) on decomposition of NaNO_2 in the presence or absence of ascorbate in solutions at pH 5.0 or 6.0 were evaluated; residual NaNO_2 concn. were determined before and after heating for 1 h at 75°C , either immediately after preparation of the solution or after holding at 4°C for 72 h. Tables of results are given. The results showed that all the additives and metal ions tested promoted nitrite decomposition in the presence of ascorbate; in the absence of ascorbate, only Fe^{2+} promoted ascorbate decomposition. Nitrite decomposition was greater at pH 5.0 than at pH 6.0, and greater immediately after solution preparation than after holding at 4°C . Further studies were conducted on the effects of low-molecular constituents of porcine skeletal muscle sarcoplasm (separated by gel filtration) on nitrite decomposition and cured meat colour formation. Results showed that reduced glutathione enhances colour formation and nitrite decomposition. Neither IMP nor ATP had any effect in the absence of glutathione; in the presence of glutathione, IMP enhanced nitrite decomposition and ATP enhanced colour formation. AJDW

37

Nitrate and nitrite allowances in meat products. (In "Proceedings of the International Symposium on Nitrite in Meat Products".) [Conference proceedings]

Meester, J. (Netherlands, Central Institute for Nutrition & Food Research TNO)
pp. 265-268 ISBN 90-220-0463-5 (1974) [En] Wageningen, Netherlands; Central Inst. for Nutr. & Food Res. TNO [Netherlands Centre for Meat Tech., Utrechtseweg 48, Zeist, Netherlands]

A summary (in tabular form) is given of permitted nitrite and nitrate concn. (quantities which may be added during manufacture and/or concn. in the final product) in various meat products in the EEC, Belgium, Denmark, France, the Federal Republic of Germany, the Republic of Ireland, Italy, Luxembourg, the Netherlands, Austria, the UK, Finland, Norway, Sweden, Switzerland, Canada, Japan and the USA. AJDW

38

[Study of nitrosamines in foods. I. Distribution of secondary amines and nitrites.]

Yim, T.-K.; Yoon, M.-C.; Kwon, S.-P.

Korean Journal of Food Science and Technology 5 (3) 169-173 (1973) [29 ref. Ko, en] [Dept. of Preventive Med. & Public Health, Coll. of Med., Yonsei Univ., Korea]

In this report the amounts and distribution of secondary amines and nitrites in basic Korean foods, kim-chi, fish, fish roe, sausages, canned fish foods and fish sauces (salted fish) were studied. Nitrite contents were low in most of the foods except sausages. Secondary amines were low in kim-chi and fish, but high in fish sauces, fish roe and canned fish foods. The result of this study suggests that the possible formation of carcinogenic nitrosamines during manufacture, storage and cooking of all Korean foods should be studied. AS

39

[Accumulation of nitrate in horticultural products.

VII. Effects of nitrogen fertilizer on the accumulation of nitrate in tomato fruit. (2).]

Miyazaki, M.; Kunisato, S.; Miya, S.

Journal of Food Science and Technology [Nihon Shokuhin Kogyo Gakkai-shi] 19 (1) 16-21 (1972) [19 ref. Ja, en] [Toyo Inst. of Food Tech., Kawanishi, Hyogo, Japan]

40

[Accumulation of nitrate in horticultural products.

VIII. Effects of nitrogen fertilizer on the accumulation of nitrate in tomato fruit. (3).]

Miyazaki, M.; Kunisato, S.; Miya, S.

Journal of Food Science and Technology [Nihon Shokuhin Kogyo Gakkai-shi] 19 (1) 22-28 (1972) [11 ref. Ja, en] [Toyo Inst. of Food Tech., Kawanishi, Hyogo, Japan]

41

[Accumulation of nitrate in horticultural products. IX. Effects of phosphate, potassium, calcium, and magnesium fertilizers on the accumulation of nitrate in tomato fruit. (1).]

Miyazaki, M.; Kunisato, S.; Miya, S.

Journal of Food Science and Technology [Nihon Shokuhin Kogyo Gakkai-shi] 19 (2) 55-61 (1972) [25 ref. Ja, en] [Toyo Inst. of Food Tech., Kawanishi, Hyogo, Japan]

42

Effect of nitrate content of ration on its level in cows' milk.

Kisza, J.; Dajnowiec, Z.; Przybylowski, P.

XIX International Dairy Congress 1E, 81-82 (1974) [En] [Inst. of Food Eng. & Biotech., Univ. of Agric., Olsztyn, Poland]

6 cows were fed (i) 100 or (ii) 200 mg NO₃-N/kg body wt. daily for 28 days. Milk yield was decreased by (i) 34% and (ii) 48%. The NO₃-N increased to (i) 33 and (ii) 50 µg/100 g milk by the 28th day but was not detectable 4 days later. JMD

43

The Perigo effect in luncheon meat.

Chang, P.-C.; Akhtar, S. M.

Canadian Institute of Food Science and Technology Journal 7 (2) 117-119 (1974) [7 ref. En, fr] [Div. of Microbiol., Food Res. Lab., Health Protection Branch, Health & Welfare Canada, Ottawa, Ontario K1A 0L2, Canada]

Growth of *Clostridium botulinum* from spores was inhibited in homogenates of luncheon meat produced commercially with varying amounts of sodium nitrite. The inhibition increased with increasing concn. of nitrite present before the heating process but could not be accounted for by residual nitrite. It is concluded that a Perigo type inhibitor is formed during commercial processing of a luncheon meat. AS

44

Shelf stable cured ham with low nitrite-nitrate additions preserved by radappertization. In "Proceedings of the International Symposium on Nitrite in Meat Products". [Conference proceedings]

Wierbicki, E.; Heiligman, F. (Netherlands, Central Institute for Nutrition & Food Research TNO) pp. 189-212 ISBN 90-220-0463-5 (1974) [37 ref. En] Wageningen, Netherlands [Irradiated Food Products Div., Food Lab., US Army Natick Lab., Massachusetts, USA]

Details are given of a series of experiments conducted to determine the min. quantities of nitrate and nitrite (in combination with ascorbate and/or erythorbate) required for formation of acceptable colour and flavour in smoked cooked ham in which *Clostridium botulinum* was controlled by radappertization. The smoked cured hams were packaged in cans or laminate pouches, and irradiated at dose rates of 3.7-4.7 Mrad at temp. of -30 to -40°C. The flavour, aroma, texture and colour of the hams were then evaluated organoleptically, and the moisture, fat, protein, salt, ash, phosphate, residual nitrate, residual nitrite, dimethylnitrosamine, methylethyl nitrosamine, diethylnitrosamine, nitrosomorpholine, nitrosopyrrolidine and nitrosopiperidine concn. were determined. Detailed tables of results are given. It is concluded that nitrite levels in radappertized ham may be reduced to 25 mg/kg;

small quantities of nitrate and ascorbate or erythorbate are necessary for flavour and colour development, and small amounts of nitrate are necessary to control rancidity in opened packs. No nitrosamines were detected in any of the ham samples tested. AJDW

45

[Nitrates, nitrites and nitrosamines in flesh and viscera of calves fed with milk substitutes containing nitrates.]

Cantoni, C.; Renon, P.; Acqua, V. I'

Archivio Veterinario Italiano 25 (1/2) 21-27 (1974) [21 ref. It, en, fr, de] [Istituto di Ispezione degli Alimenti di Origine Animale, Univ., Milan, Italy]

The effects of feeding milk replacers containing (i) 410 mg/kg or (ii) 937 mg/kg added nitrate on the nitrate, nitrite and nitrosamine concn. in liver or muscle (biceps femoris) tissue of calves were investigated. 21 Black and White calves received each level of dietary nitrate from birth up to slaughter. Liver and muscle tissue samples from (iii) 12 animals fed a normal diet were also analysed. Tables of results are given. Mean values for nitrate, nitrite and nitrosamine concn. in liver tissue were, respectively (mg/kg): (i) 19.0, 0 and 0.009; (ii) 24.5, 0 and 0.027; (iii) 0, 29.4 and 0.004. Corresponding values for muscle tissue were: (i) 4.4, 27.4 and 0; (ii) 1.7, 23 and 0.014; (iii) 1.7, 7.2 and 0. AJDW

46

[Nitrite content of meat products and possibility of developing colour in minced meat.]

Kann, Yu. M. [Kann, J.]; Tauts, O. V.; Suurtkhal', A. A. [Suurthal, A.]; Khunt, M. A. [Hunt, M.] *Tallinna Polütehnilise Instituudi Toimetised, A* No. 331, 103-108 (1973) [4 ref. Ru, de]

The following mean values with ranges were obtained for nitrite contents (mg/100 g) of meat products (numbers of samples in parentheses): cooked sausage (17), 7.69 and 4.86-11.16; frankfurters and fresh sausages (8), 7.72 and 5.44-11.42; half-smoked sausage (21), 3.31 and 0.77-5.77; smoked sausage (6), 2.95 and 1.43-3.71; and smoked meat (18), 4.99 and 1.29-7.99. No nitrites were detected in minced meat. Tests on colour development in minced meat were carried out using NaNO_2 , ascorbic acid and nicotinic acid. Max. development was obtained with 5 mg NaNO_2 /100 g, which should allow reduction of nitrite addition to meat products by nearly half. Ascorbic acid at 1-300 mg/100 g had no effect. Nicotinic acid at 5-10 mg/100 g developed the colour but to a lesser extent than NaNO_2 , best effect being obtained at 50-80°C. SKK

47

[On the hygienic quality of some Finnish baby-food conserves.]

Raunio, P.

Suomen Eläinlääkärilehti 80 (9) 442, 447-451 (1974) [8 ref. Fi, en] [Eläinlääketieteellinen

Korkeakoulu, Elintarvikehygienian Laitos, Hämeentie 57, 00550 Helsinki 55, Finland]

The bacteriological quality and the nitrate and nitrite content of some Finnish baby-food conserves were investigated. The baby-food conserves were found to be bacteriologically negative. The determination of nitrate was done by the method in which the nitrate is reduced to nitrite by a cadmium column, and by a modification of this method. This modification was found to be more efficient than the original method, especially if the sample contained a relatively high amount of nitrate. The nitrate contents of some samples containing spinach were in excess of the recommended level, 300 mg/kg. Therefore some deep-frozen spinach and whole-grain spinach cereals were also analysed for their nitrate content. The concn. were very high. AS

48

[Accumulation of nitrate in horticultural products. X. Effects of microelements on accumulation of nitrate in tomato fruit.]

Miyazaki, M.; Kunisato, S.; Miya, S.

Journal of Food Science and Technology [Nihon Shokuhin Kogyo Gakkai-shi] 19 (9) 418-422 (1972) [20 ref. Ja, en] [Toyo Inst. of Food Tech., Kawanishi, Hyogo, Japan]

This is the result of studies on elements other than P, K, Ca, and Mg on the same plots of sand reported in part IX [see FSTA (1975) 7 3J383]. When Fe concn. of culture solution was $10 \times$ the standard, NO_3 content of fruits tended to increase remarkably. Cu had a similar effect. In the plot with $10 \times$ the normal concn. of Zn, NO_3 content of fruits tended to decrease remarkably. In the plot deficient in Mo, fruits contained a high amount of NO_3 but no Mo. Mn and B had no significant influence on NO_3 content of fruits. SKa

49

[Accumulation of nitrate in horticultural products. XI. Variation in nitrate content of tomato fruits among five varieties. I.]

Miyazaki, M.; Kunisato, S.; Miya, S.

Journal of Food Science and Technology [Nihon Shokuhin Kogyo Gakkai-shi] 19 (9) 423-428 (1972) [14 ref. Ja, en] [Toyo Inst. of Food Tech., Kawanishi, Hyogo, Japan]

5 var. were compared: (i) Fireball, (ii) Amateur, (iii) Chiko, (iv) Heinz 1370, and (v) Brehm's Solid Red. NO_3 content of mature fruits was high in (i) and (ii); high at early harvest and lower at normal and late harvest in (iii); and low in (iv) and (v) at all harvesting periods. It decreased remarkably from the mature green stage to red ripe in (iii), (iv), and (v). Concn. of minerals showed no significant difference in (i) and (ii) vs. (iii), (iv), and (v), but fruits of (i) and (ii) had higher NO_3 , P, and K and lower Ca than those of (iii), (iv) and (v). Nitrate reductase activity was high in leaf blades, less high in leaf-stalks and calyces, and very low in fruits. It almost disappeared in fruits when reddening began. However, these changes in reductase activity could not explain the differences in NO_3 contents of fruits. SKa

50

[Accumulation of nitrate in horticultural products. XII. Effect of nitrate, potassium, calcium, magnesium, and phosphate fertilizers on the accumulation of nitrate in tomato fruit.]

Miyazaki, M.; Kunisato, S.; Sugihara, H.; Yabuuchi, K.

Journal of Food Science and Technology [Nihon Shokuhin Kogyo Gakkai-shi] 19 (9) 429-437 (1972) [14 ref. Ja, en] [Toyo Inst. of Food Tech., Kawanishi, Hyogo, Japan]

Experiments were made on var. Fireball in sand culture. When NO_3 concn. of culture solution (CS) was high and K concn. was high, NO_3 concn. of fruit was high. When K concn. of CS was lower, NO_3 content decreased. When K concn. of CS was extremely low, NO_3 concn. decreased further, even if CS contained more NO_3 . Thus, the effect of NO_3 was influenced by K concn. When CS contained sufficient amounts of both NO_3 and K, an increase in Ca concn. in CS did not remarkably lower NO_3 concn. of fruit, but when CS contained insufficient amounts of either NO_3 or K, an increase in Ca concn. lowered the NO_3 concn. of fruit remarkably. Concn. of P and Mg in CS had no clear influence. SKa

51

[Determination of nitrite in milk.]

Laskowski, K.; Bierska, J.

Roczniki Instytutu Przemysłu Mleczarskiego 16 (1) 71-78 (1974) [13 ref. Pl, ru, en] [Inst. Przemysłu Mleczarskiego, Warsaw, Poland]

Milk is deproteinized and defatted using the Carrez reagent (equal vol. of aqueous solutions of zinc sulphate and potassium ferrocyanide) at 80°C , and is then steam-distilled at pH 3.2-3.8. Nitrite is determined in the condensate by a colorimetric method using sulphanilic acid and α -naphthylamine (Griess reagent). Recovery is complete for quantities of $\leq 25 \mu\text{g}\%$, but then gradually decreases to approx. 83% at $300 \mu\text{g}\%$ unless quantity of condensate is increased. Accuracy is approx. 4% at quantities of $\leq 50 \mu\text{g}\%$. FL

52

Determination of nitrites in milk. [Conference proceedings]

Laskowski, K.; Bierska, J.

XIX International Dairy Congress 1E, 473-474 (1974) [En] [Inst. of Dairy Ind., Warsaw, Poland]

53

Determination of nitrates, nitrites and nitrosamines in cheeses. [Conference proceedings]

Laskowski, K.; Bierska, J.

XIX International Dairy Congress 1E, 514-515 (1974) [2 ref. En] [Inst. of Dairy Ind., Warsaw, Poland]

A clarified, aqueous-extract of the cheese is used. 0.125 ppm nitrate can be estimated from the pink colour developed with brucine in conc. H_2SO_4 . If nitrite is detected with Griess reagent, the aqueous

extract is steam-distilled at pH 8 (nitrosamines can be estimated by TLC in this distillate) and at pH 3.2-3.5; 0.01 ppm nitrite can be estimated in the 2nd distillate. JMD

54

Processing meat products without nitrates or nitrites. [Review]

Kelly, R. F.

Food Product Development 8 (7) 38-39, 42, 44 (1974) [En] [Dept. of Food Sci., & Tech., Virginia Polytech. Inst., Blacksburg, Virginia, USA]

55

[Wine in long-life sausages.]

Ubertalle, A.

Industria Alimentari 13 (9) 145-151 (1974) [5 ref. It] [Univ. di Bologna, via S. Giacomo, 11, Italy]

Details are given of studies on the addition of wine to long-life sausages. The sausage mix was divided into 4 parts to which were added: (i) 9% medium dry red wine, no nitrates; (ii) as (i) plus 200 mg/kg potassium nitrate; (iii) no wine, 200 mg/kg potassium nitrate; and (iv) no wine or nitrates (control). Each batch was refrigerated at 4°C for 24 h before being encased. Examinations were carried out at intervals for 200 days. Results, given in tabular form, covered moisture, ammonia, ethanol, vitamin B₁, water-soluble N and peroxide value. It was shown that addition of 8-10% of a choice red wine to long-life sausages enhanced their flavour and keeping quality, obviating the need of nitrates as preservatives. Wine should therefore be considered an ingredient and not a flavouring. CR

56

Nitrate and nitrite substitutes in meat curing.

Kemp, J. D.

Food Product Development 8 (8) 64, 67-68, 70 (1974) [12 ref. En] [Dept. of Animal Sci., Univ. of Kentucky, Lexington, Kentucky, USA]

Curing reactions involving colour which take place when using nitrite are first examined. Compounds which have been used with partial success as nitrite substitutes in its role in colour formation are listed and discussed. Flavour, bactericidal and antioxidant effects of nitrite are also considered. VJG

57

[Stabilization of colour of cured meat using nitric oxide.]

Pal'min, V. V.; Prizenko, V. K.

Izvestiya Vysshikh Uchebnykh Zavedenii, Pishchevaya Tekhnologiya No. 3, 51-53 (1974) [6 ref. Ru] [Moskovskii Tekh. Inst. Myasnoi i Molochnoi Promyshlennosti, USSR]

The colouring of the finished product was studied during the addition of NO to force-meat in the course of sausage manufacture. In spite of low

solubility of NO in water, the quantity dissolved was sufficient to stabilize the colour of the product. The addition of NO also allows reduction of the amount of nitrites. Addition of ascorbic acid enhanced considerably the colour formation and sharply reduced the content of residual nitrites in the finished products. The accumulation of nitrosopigments occurred mainly during heat processing. STI

58

[Studies on in vivo formation of nitroso compounds.]

Harada, M.; Ishiwata, H.; Nakamura, Y.; Tanimura, A.; Ishidate, M.

Journal of the Food Hygienic Society of Japan

[Shokuhin Eiseigaku Zasshi] 15 (3) 206-207

(1974) [14 ref. Ja] [Nat. Inst. Hyg. Sci.,

Kamiyoga 1-chome, Setagaya-ku, Tokyo, Japan]

Nitrites and nitrates contained in human saliva were analysed. For 14 male and female adults, the concn. of nitrite ion and nitrate ion were 2.2-12.1 ppm and 8.6-109.6 ppm, respectively. It was found that these concn. were much increased by intake of vegetables. TM

59

A new method for obtaining nitrate-free whey when manufacturing round-holed cheese.

[Conference proceedings]

Syrjanen, H.

XIX International Dairy Congress 1E, 711 (1974)

[En] [Swedish Dairies Assoc., Gullandet, Sweden]

The contamination with potassium nitrate of most (90-95%) of the whey in the manufacture of Herrgard and Drabant cheese (both with round eyes) is avoided by adding all the chemical to the water in the pressing vat to which the curd whey mixture from the cheese vat is transferred via a whey separator (the pressing vat in normal manufacture contains whey). This method allows the nitrate content to be adjusted to 30-40 ppm in fresh cheese from the press, which is adequate to prevent undesirable fermentations without decreasing the quality of the cheese. FL

60

Studies on possibility of formation of N-nitrosamines in cheeses. [Conference proceedings]

Kisza, J.; Przybylowski, P.; Dajnowiec, Z.

XIX International Dairy Congress 1E, 426-427

(1974) [3 ref. En] [Inst. of Food Eng. & Biotech., Univ. of Agric., Olsztyn, Poland]

Cheese made from milk containing 40-51 or 980 µg nitrate/100 g, and with or without a *Streptococcus lactis* + *Str. diacetylactis* + *Lactobacillus casei* starter, contained no nitrates after 4 wk ripening. Nitrates were still present in cheese ripened for 6 wk when made with a *Str. lactis* + *Str. diacetylactis* starter. Nitrosamine formation (detected in only 1 cheese) was inhibited by starters capable of breaking down nitrates. MEG

61

[Nitrate, nitrite and bacteria in curing of meat products.] Nitrat, Nitrit und Bakterien bei der Herstellung von Rohpökelfwaren.

Pfeil, E.; Liepe, H.-U.

Fleischwirtschaft 54 (11) 1717-1718 (1974) [De]

[Philipps-Univ., 355-Marburg, Federal Republic of Germany]

The role of bacterial action in reduction of NO_3^- to NO and formation of nitrosomyoglobin is outlined. The possibility of smaller NO_3^- additions in fermented sausages by controlling the rate of pH reduction through starter cultures is discussed.

RM

62

Investigations on the possible occurrence of nitrosamines in Lebanon bologna.

Palumbo, S. A.; Smith, J. L.; Gentilcore, K. M.; Fiddler, W.

Journal of Food Science 39 (6) 1257-1258 (1974)

[14 ref. En] [USDA, E. Regional Res. Center, Agric. Res. Service, Philadelphia, Pennsylvania 19118, USA]

Examination of Lebanon bolognas produced commercially and in an experimented plant revealed absence of detectable levels of 6 volatile nitrosamines. Assays for pH, nitrite and nitrosamines were conducted daily during the fermentation and after 4 and 12 days storage at 5°C. IFT

63

[Free and bound nitrites in meat products.]

Cantoni, C.; Renon, P.; Maccapani, M.

Industria Alimentari 13 (9) 129-131 (1974) [10

ref. It, en] [Istituto Ispezione Alimenti Animali, Univ. Milan, Italy]

Various types of cooked meats (sausages, cooked ham, corned beef, liver pate, canned meat) were used to determine the reaction of nitrites added to the meat mixtures. The tabulated results show the amounts of nitrites present in the finished products in mg/kg. Free NO_2 ranged from 0 to 202.5 mg/kg and bound NO_2 from 1.5 to 52.4 mg/kg. Contents of NO_2 bound to the sarcoplasmic and myofibrillar fractions are also given. Detn. of free and bound nitrites is a useful aid in cases of abnormal fermentations or discolouring in deciding whether to increase the nitrites concn. of the product. CR

64

Reaction of nitrite with sulphhydryl groups of myosin.

Kubberod, G.; Cassens, R. G.; Greaser, M. L.

Journal of Food Science 39 (6) 1228-1230 (1974)

[17 ref. En] [Norwegian Food Res. Inst., Box 50, 1432 AAS-NLH, Norway]

Isolated myosin from rabbit muscle was incubated with different concn. of nitrite under different pH and temp. conditions. The free SH content was determined spectrophotometrically using 5,5'-dithiobis (2-nitrobenzoic acid) as the colour forming reagent. At room temp., pH 3.0 and

a NaNO_2/SH molar ratio of 1000:1, the disappearance of detectable SH groups from myosin was complete in <10 min. Higher pH levels decreased the reaction rate; at pH 6.0, 30% of the SH groups reacted during a 3-h incubation. Decreasing the NaNO_2/SH molar ratio also lowered the rate of reaction; equimolar amounts gave no detectable reactions after 3 h at pH 6.0. Increasing the temp. increased the reaction rate; a 20% loss in SH groups was detected after 3-h treatment of equimolar amounts at 100°C and pH 6.0. An attempt was made to compare loss of SH groups with a loss of nitrite. At pH 5.0 and a NaNO_2/SH molar ratio of 1:1 the loss (9.1%) in SH after 60 min heating at 100°C under anaerobic conditions was balanced by a nearly equimolar loss (8.4%) in free nitrite in the reaction mixture. 20% of this nitrite was converted into nitrosothiols. By considering the nitrite concn., pH and temp. conditions usually found in a meat product, it appears that the direct reaction between nitrite and SH groups in the myosin is responsible for only a small proportion of the total nitrite lost in the curing process. IFT

65

[Determination of nitrates in foods.]

Volff, R.; Noyelle, G.; Gaurrat, C.

Annales des Falsifications et de l'Expertise Chimique 67 (723/724) 599-608 (1974) [5 ref. Fr] [Inst. Appert, 44 rue d'Alesia, 75014 Paris, France]

The homogenized sample (1-10 g) suspended in 100 ml water containing borax is deproteinized by treatment with 2 ml $\text{K}_4\text{Fe}(\text{CN})_6 \cdot 3\text{H}_2\text{O}$ (106 g/l.) and 2 ml zinc acetate (220 g/l.). Nitrites present in the filtrate (10 ml) are measured colorimetrically (at 520 nm) after reaction with 10 ml Griess' reagent (a mixture of equal parts of sulphanilic acid (0.6 g/100 ml) and α -naphthylamine HCl (0.03 g/100 ml) solutions). Nitrates present in the filtrate are measured as nitrites after addition of 2 g reduced Cd + 5 ml NH_4Cl buffer at pH 9.6 for a portion of filtrate containing $\leq 200 \mu\text{g}$ nitrates. MEG

66

Nitrate and nitrite contents in Norwegian food.

[Conference proceedings]

Hoyem, T.

IV International Congress of Food Science and Technology 9c, 21-23 (1974) [En] [Norwegian Food Res. Inst., Box 50, 1432 As-NLH, Norway]

Data are tabulated for consumption (kg/yr), with nitrate intake per capita (mg KNO_3/yr) and nitrite intake per capita (mg NaNO_2/yr) of water, vegetables, cereals, meat and its products, fish and products, cheese and milk in Norway. Vegetables, especially potatoes, cabbage and carrots which constitute the bulk of vegetable consumption in Norway, are responsible for 90-98% of the nitrate intake, while fish and fish products, meat products, cheese and drinking water are of minor importance. The overall nitrite intake seems negligible. A

further significant reduction of the nitrate/nitrite intake can only be achieved by reducing the nitrate content in vegetables, combined with proper storage conditions to prevent the transformation of nitrate to nitrite. AS

67

C-nitrosation products in food. [Conference proceedings]

Knowles, M. E.; Gilbert, J.; McWeeny, D. J.

IV International Congress of Food Science and Technology Abstracts of Papers 9a, 214 (1974) [En] [Food Sci. Div., Min. of Agric., Fisheries & Food, Colney Lane, Norwich NOR 7OF, UK]

The reactions of nitrite with food components may give rise to the formation of trace amounts of nitrosamines but many other reactions may also take place, leading to quite different compounds. Investigations are reported on the possible formation of C-nitroso compounds from various substances present in cured food. These demonstrate that there can be reaction with the tyrosine residues of proteins, the phenols encountered in smoked cured meats and some permitted food colours. AS

68

Problems arising from the use of nitrites in food processing. [Conference proceedings]

Friedman, L.

Proceedings of the Meat Industry Research Conference pp. 11-20 (1973) [En] [Div. of Toxicol., FDA, Washington, DC 20204, USA]

Possible formation of nitrosamines by reaction of amines with nitrite added to foods is discussed, with reference to: nitrosamines in nitrite-cured meat or fish products; nitrite formation in the stomach; the importance of nitrites in the control of *Clostridium botulinum* in foods; the role of nitrites in flavour formation in cured meats; use of nitrite in combination with ascorbic acid; problems of evaluation of the carcinogenic activity of dietary nitrites or nitrosamines; and problems of establishment of an acceptable nitrite and or nitrosamine concn. in the diet. Other toxic effects of nitrites are also briefly discussed. AJDW

69

Effect of electrolytic tinplate and pack variables on the shelf life of canned pure citrus fruit juices.

Semel, A.; Saguy, M.

Journal of Food Technology 9 (4) 459-470 (1974) [22 ref. En] [Packaging Res. Lab., Div. of Food Tech., Volcani Center, POB 6, Bet Dagan, Israel]

Corrosion performance in citrus fruit juices of 5 different batches of electrolytic tinplates having values of special properties test values outside of type K tinplate specifications was studied. The effect of ATC (alloy tin couple) values was followed in order to find out the precise limits for an adequate shelf life in citrus fruit juice packs. The effect of different levels of nitrate (30 and 60 ppm) and SO_2 (10 and 20 ppm) relation to ATC values

was investigated. It was shown that: certain ATC values are necessary in order to obtain a good shelf life in pure juices and those values are different for orange and grapefruit juices; and while ATC value can affect the detinning rate in pure citrus juices, the addition of nitrate and SO_2 at the concn. used overrides this effect. AS

70

Influence of different mineral nutrition on the content of nitrate and nitrite in spinach.

[Conference proceedings]

Grujic, S.; Kastori, R.

IV International Congress of Food Science and Technology Abstracts of Papers 9a, 210 (1974) [En] [Chem. Dept., Fac. of Agric., Univ. of Novi Sad, Yugoslavia]

Means of reducing excessive concn. of nitrates and nitrites in spinach leaves which occur with excessive N intake were studied. Significant decreases were obtained by increasing the K concn. in the substrate. ELC

71

[A bacteriological study on the keeping quality of Vienna sausages. III. Inhibitory effects of furylfuramide, sorbic acid and nitrite upon growth of *Clostridium welchii*.]

Konuma, H.; Suzuki, A.

Journal of the Food Hygienic Society of Japan [Shokuhin Eiseigaku Zasshi] 15 (4) 243-251 (1974) [21 ref. Ja, en] [Nat. Inst. Hygienic Sci., Kamiyoga 1-chome, Setagaya-ku, Tokyo, Japan]

Anaerobic bacteria isolated from commercial samples of Vienna sausages were identified as thermolabile *Clostridium welchii*. Furylfuramide at a concn. of 0.31-1.25 ppm was effective for inhibition of in vitro growth of the isolated *C. welchii*. The inhibitory effects of nitrite and sorbic acid were also studied.

TM

72

Influence of nitrite on meat flavour. [Conference proceedings]

Bailey, M. E.; Swain, J. W.

Proceedings of the Meat Industry Research Conference pp. 29-45 (1973) [24 ref. En] [Food Sci. & Nutr. Dept., Univ. of Missouri, Columbia, Missouri 65201, USA]

Literature data on the flavour of nitrite-cured meats is discussed, with reference to: taste panel studies on flavour differences between cured and non-cured frankfurters and ham; effects of smoking, storage time and other factors on sensory differentiation of cured and non-cured meats; GLC studies on volatiles in cured meat; and possible mechanisms for the effect of nitrites on the flavour of cured meats (with special reference to the suggestion that nitrite retards lipid oxidation by formation of a complex with iron porphyrins).

AJDW

73

Possibilities for nitrite quantity decrease in brines.

[Conference proceedings]

Rahelic, S.; Pribis, V.

IV International Congress of Food Science and Technology 9c, 24-26 (1974) [En] [Dept. of Meat Tech., Fac. of Tech., Univ. of Novi Sad, Akademaska 2, Yugoslavia]

It was shown that the min. amount of nitrite required to produce the desired pink colour of cured meat is much lower than the levels permitted by legislation, and a reduced nitrite content in curing brines would reduce the possibility of formation of toxic nitrosamines. Pig muscles were injected with 6.2 to 9% of brine containing nitrite levels from 5.4 to 139 ppm; samples were processed by mechanical tumbling, followed by boiling at 80°C for 60 min. Trials were also made with and without addition of ascorbic acid. Mean values of residual NaNO_2 in the meat after cooking are given. The lowest nitrite injection level of 5.4 ppm, combined with mechanical treatment, produced a satisfactory colour. Less residual nitrite was present after cooking when meat was cured in brines containing ascorbic acid. ELC

74

Possible substitutes for nitrite in cured foods.

[Conference proceedings]

Brown, W. D.

Proceedings of the Meat Industry Research Conference pp. 21-27 (1973) [8 ref. En] [Inst. of Marine Resources, Dept. of Food Sci. & Tech., Univ. of California, Davis, California 95616, USA]

Brief details are given of studies conducted on possible nitrite substitutes for production of the typical colour of cured meats. Studies were conducted in model systems containing myoglobin, or in a sausage formula. Compounds tested included derivatives of imidazole, tetrazole, nicotinic acid and nicotinamide. Aspects considered include: the mechanism of pigment formation; effects of temp. and O_2 on colour stability; and possibility undesirable properties, e.g. vasodilation, of the compounds used. Good results were achieved with methyl nicotinate, hexyl nicotinate, N,N-diethylnicotinamide and pentaerythritol tetranicotinate. AJDW

75

Current status of nitrite usage in the USA.

[Conference proceedings]

Mussman, H. C.

IV International Congress of Food Science and Technology Abstracts of Papers 9a, 219 (1974) [En] [Sci. & Tech. Services, Animal & Plant Health Inspection Service, USDA, Washington, DC 20250, USA]

Current research (official, industrial and private), findings of nitrosamines in commercial products and governmental inquiries in progress in the USA on potential hazards associated with the use of

nitrite in meat curing are reviewed. The present view is that some use of nitrite should continue in meat curing to preclude the development of toxin by *Clostridium botulinum*; however, discussions in progress may lead to some revision of regulations. ELC

76

The effect of nitrite on botulinal toxin formation in bacon. [Conference proceedings]

Greenberg, R. A.

Proceedings of the Meat Industry Research Conference pp. 69-70 (1973) [En] [Res. & Development Center, Swift & Co., Oak Brook, Illinois 60521, USA]

Brief details are given of a study on factors influencing growth and toxin production by *Clostridium botulinum* in bacon. Factors studied were initial nitrite concn. (0, 30, 60, 120, 170 or 340 ppm), inoculum size (200 spores/g or 22 600 spores/g) and inoculation time (before or after curing). The bacon samples were then incubated at 80°F, and tested for toxin at intervals. With the lightly inoculated product, toxin formation decreased with increasing nitrite level, and no toxin was formed in samples made with 170 or 340 ppm nitrite. With the heavily-inoculated sample, toxin formation occurred at all levels of added nitrite, but with decreasing frequency as the nitrite level increased. Time of inoculation had no effect on toxin formation. Residual nitrite disappeared rapidly during incubation of the bacon. The possible presence of a Perigo factor in bacon is briefly discussed. AJDW

77

[Contamination of pork products.]

Henry, M.; Frouin, A.; Barraud, C.

Revue Francaise de Dietetique 18 (70) 19-24 (1974) [Fr] [Service de Recherches de la Ste Olida-Caby, 114 Rue Baudin - 92300 Levallois-Perret, France]

Problems of chemical contamination of cured pork products are discussed, with reference to: the toxicity of nitrates, nitrites and nitrosamines; the role of nitrites in control of bacterial growth in cured meat products; and EEC regulations for curing salts. AJDW

78

[Inhibition of *Clostridium sporogenes* multiplication by mixtures of cysteine, NaNO_2 and NaCl .]

Baldini, P.

Industria Conserve 49 (4) 232-234 (1974) [10 ref. It] [Sta. Sperimentale per l'Ind. delle Conserve Alimentari, Parma, Italy]

Model studies were made of the inhibition of *Cl. sporogenes* by mixtures of ≤ 340 ppm NaNO_2 , 0.0075-0.075% cysteine or 0.075% methionine, 0.75% NaCl and 0.04% FeSO_4 added to the culture medium and incubated for 40 days at 30°C. Results indicated that a heat-labile inhibitory complex, probably a nitrosothiol, was formed from cysteine

+ NO_2^- . No inhibitory effect was obtained by replacing cysteine with methionine, suggesting that the -SH group is involved in complex formation. Addition of FeSO_4 allowed reduction of NaNO_2 content to 17 ppm: no increase in bacterial population occurred after 40 days' incubation with a 17 ppm NaNO_2 , 0.0075% cysteine and 0.04% FeSO_4 mixture. RM

79

[Inhibitory action of mixtures of sodium ascorbate, nitrite and chloride on growth of *Clostridium sporogenes*.]

Baldini, P.; Ambanelli, G.; Casolari, A.

Industria Conserve 49 (3) 155-158 (1974) [20 ref. It, de, en, fr]

In vitro studies were made of the inhibition of *Cl. sporogenes* by mixtures of 17-340 ppm NaNO_2 , 0.01-0.10% sodium ascorbate, 0.07-0.75% NaCl and 0.04% FeSO_4 during pasteurization and sterilization at 40-100°C. At all temp. $>40^\circ\text{C}$, NaNO_2 -ascorbate mixtures were more effective than NaNO_2 alone, and their efficiency was enhanced by NaCl and FeSO_4 . Complete inhibition (no growth during 42 days at 30°C) was achieved at 65°C by 51 ppm NaNO_2 , at 70°C by 17 ppm NaNO_2 , and at 75°, 85° and 100°C by 51 ppm NaNO_2 in the presence of the other 3 compounds. This was attributed to the formation of a compound from nitrite and ascorbic acid with superior inhibitory action. This would allow a reduction in the level of nitrite addition to meat products. RM

80

A new method for the determination of nitrates in drinking water. [Letter]

Monselise, J. I.

Israel Journal of Technology 11 (3) 163 (1973) [1 ref. En] [Lab. of Assis Ltd., Ramat Gan, Israel]

An UV spectrophotometric method for determination of NO_3^- in drinking water was developed, based on measurement of the absorbance at 220 nm. This method was compared with the American standard method for examination of water and waste water. The same results were obtained in both methods in the 1-20 ppm range. Na_2CO_3 was the only interfering salt in the optimum range used for NO_3^- . GL

81

Curing process.

Unilever Ltd.

British Patent 1 377 154 (1974) [En]

The free nitrite content in cured meat is destroyed by treatment with SO_2 . IFT

82

Effect of nitrite and other factors on the physico-chemical characteristics and nitrosamine formation in bacon. [Conference proceedings]

Herring, H. K.

Proceedings of the Meat Industry Research Conference pp. 47-60 (1973) [12 ref. En]

[Armour & Co., Food Res. Lab., Oak Brook, Illinois 60521, USA]

Brief details are given of studies on the effects of added nitrite (≤ 170 ppm) and vacuum packaging on the composition and quality of bacon and the effects of added nitrite (≤ 170 ppm), ascorbate or isoascorbate (≤ 2000 ppm) and meat storage before processing on nitrosopyrrolidine formation in fried bacon. Tables of results are given. Residual nitrite and nitrate concn. increased and colour, flavour and shelf-life improved with increasing levels of added nitrite. Nitrite delayed growth of bacteria and moulds; this effect was more marked with high levels of added nitrite. Vacuum-packaged bacon had a longer shelf-life than non-vacuum packaged samples. Uncooked bacon contained no nitrosopyrrolidine. In cooked samples, the nitrosopyrrolidine concn. increased with increasing level of added nitrite. Pan frying gave the highest nitrosopyrrolidine concn., followed by oven baking. Microwave cooking gave relatively low nitrosopyrrolidine concn. Addition of high concn. of ascorbate or isoascorbate almost completely prevented nitrosopyrrolidine formation in fried bacon. Storage of pork bellies before processing had no clear effect on nitrosopyrrolidine formation. AJDW

83

[Method and device for effecting colour formation in meat products.]

Nilsen, G. (Stabburet AS)

Norwegian Patent Application 130 663 (1974) [No]

A pleasant golden reddish-brown colour is produced in the surface layer of meat products, particularly various types of sausages (without an addition of nitrate, nitrite or colourings), by treatment of the product with small amounts of nitrous gases mixed with air and/or smoking gases. The nitrous gases are produced by passing air over an electric heating element or gas flame maintained at a temp. of 2000°C to obtain a concn. of 10 ppm nitrous gases in the gas mixture. The nitrite content of the sausages after treatment is approx. 1-2 ppm. W&Co

84

[Reactions between nitrites and SH groups of foods during digestion.]

Cantoni, C.; Cattaneo, P.

Industria Alimentari 13 (12) 63-68 (1974) [21 ref. It, en] [Istituto di Ispezione degli Alimenti di Origine Animale, Univ., Milan, Italy]

Data are tabulated for total sulphhydryl group contents (determined on extracts by the sodium nitroprusside reaction and spectrophotometry at 500 nm) of 5 pasta dishes; a sausage and rice product; 5 meat, poultry or fish dishes; 3 vegetable dishes; pears and apples; and for contents of total and/or free sulphhydryls in pig meat, beef, beef and calf liver, and turkey, chicken and horse muscle, determined by 3 different methods [Ellman, Archives of Biochemistry & Biophysics (1959) 82, 70; Sedlak & Limdsy, Analytical Biochemistry

(1968) 25, 192; and the method of Sasago et al., as modified by Fishwick and Zmarlich, FSTA (1970) 2 9S980]. Formation of nitrosothiols during reaction of extracts of beef and pig meat with simulated gastric juice was studied. It is considered that because of the high sulphhydryl content of foods, production of nitrosamines in the stomach is unlikely. SKK

85

The significance of nitrates in food and potable waters.

Schuphan, W.

Qualitas Plantarum - Plant Foods for Human Nutrition 24 (1/2) 19-35 (1974) [25 ref. En] [Bundesanstalt für Qualitätsforschung pflanzlicher Erzeugnisse, D 6222 Geisenheim/Rh., Federal Republic of Germany]

The potential health hazard from high nitrate concn. in ground water in vegetables is discussed, with reference to effects of excessive levels of N fertilization. Brief details (with tables and graphs of results) are given of an extensive series of studies on the effect of N fertilization on the concn. of nitrates and other constituents in spinach, cabbage, and kale. The results showed that the nitrate concn. increased with increasing N application; 2,4-D treatment and low light intensity also increased nitrate accumulation. Nitrate concn. also increased with increasing N application, and increased rapidly during transport and storage of the vegetables. Adverse effects of excessive levels of N fertilizers on the concn. of other nutrients (K, Ca, Cl, P, Mg, S, Na, essential amino acids) in vegetables are also briefly discussed. Effects of blanching conditions on losses of nitrates, sugar, ascorbic acid and minerals from vegetables are briefly discussed. GL

86

[Germination of spores of *Clostridium* species capable of causing food poisoning. III. Effect of some food additives on the germination of spores of *Cl. botulinum* type E.]

Ando, Y.

Journal of the Food Hygienic Society of Japan [Shokuhin Eiseigaku Zasshi] 15 (4) 292-296 (1974) [10 ref. Ja, en] [Hokkaido Inst. of Public Health, Nishi 12, Kita 19, Kita-ku, Sapporo, Japan] NaCl at a concn. of 3% and NaNO_2 at a concn. of 1% inhibited germination.

TM

87

[Germination of spores of *Clostridium* species capable of causing food poisoning. VI. Effect of some food additives on the germination of spores of a heat-sensitive strain of *Cl. perfringens* Type A.]

Ando, Y.

Journal of the Food Hygienic Society of Japan [Shokuhin Eiseigaku Zasshi] 15 (5) 377-380 (1974) [5 ref. Ja, en] [Hokkaido Inst. of Public Health, Kita-ku, Kita 19, Nishi 12, Sapporo, Japan]

A medium containing NaCl in a concn. of not more than 2% stimulated germination of a heat-sensitive strain of *Cl. perfringens* Type A, but

inhibited germination at higher concn. Outgrowth of spores was completely prevented by 6% NaCl. 0.06% NaNO_2 also prevented outgrowth. TM

88

An improved method for the determination of nitrate and nitrite in fresh and canned fruit and vegetable products.

Eipeson, W. E.; Mahadeviah, M.; Gowramma, R. V.; Sastry, L. V. L.

Journal of Food Science and Technology, India 11 (5) 209-212 (1974) [20 ref. En] [Central Food Tech. Res. Inst., Mysore, India]

The interference by natural constituents of fruit and vegetables and Sn (present in canned products) in the 1-naphthyl amine method for detn. of nitrates/nitrites was studied. Tables and graphs of results are given. Dissolved Sn was removed by passing clarified extracts of canned fruit and vegetable products through a cation exchange resin column leaving <50% Sn in the undissolved form. Nitrate recovery was approx. 96% compared with 9-15% for samples before passing through the column. Fe and organic acids did not interfere in the estimation of nitrates and nitrites. Treatment of extracts containing ascorbic acid with CuSO_4 and warming to 80°C quantitatively removed most of the inhibitory effect of ascorbic acid. Recovery was 99% compared with 21% for samples without this treatment. Nitrates/nitrites recovery from tomato paste (a typical product which interferes in the estimation) was 95% after treatment with activated charcoal compared with 33% for samples before treatment. GL

89

[Presence of nitrates, nitrites and N-nitrosamines in ripened cheese.]

Laskowski, K.; Bierska, J.; Kaminski, J.; Skwarska, S.; Soltys, W.; Szymanska, D.; Dajnowiec, Z.

Roczniki Instytutu Przemysłu Mleczarskiego 16 (2) 63-76 (1974) [19 ref. Pl, ru, en] [Inst. Przemysłu Mleczarskiego, Warsaw, Poland]

In an examination of samples of different cheeses intended for the market throughout Poland carried out during Nov. 1972-Sept. 1973, % of cheeses in which nitrates and nitrites respectively were detected were (numbers of samples examined in parentheses): Edam cheese (256), 15 and 63; Gouda cheese (190), 13 and 61; Tilsit cheese (162), 13 and 56; and Warminski, Podlaski and Salami cheeses (43), 14 and 59. No N-nitrosamines were detected in any of the samples. 5 batches each of Edam, Gouda and Tilsit cheeses were made industrially under the supervision of the Warsaw Dairy Industry Institute with the addition of 20 g saltpetre/100 l. cheese milk; only nitrites were detected in them, in some up to the 12th wk of ripening. SKK

90

Determination of nitrate in water with an ammonia probe.

Mertens, J.; Winkel, P. van den; Massart, D. L.

Analytical Chemistry 47 (3) 522-526 (1975) [24 ref. En] [Lab. Analytische Chemie, Farmaceutisch Inst., Vrije Univ., Brussels, Belgium]

This article describes manual and automatic procedures for the determination of nitrates in water containing ammonia by means of an ammonia probe. The nitrates are determined by measuring the ammonia produced during a heterogeneous reduction by means of Devarda alloy powder. The yield of the nitrate reduction with the Devarda alloy was quantitative. The method shows good accuracy and reproducibility and can be applied to waters ranging from mineral water to sewage. Procedures for the elimination of excess ammonium and nitrite are proposed. Other reduction methods (e.g. Al powder), which did not yield such good results, are also discussed, and manual and automatic methods are compared. AS

91

Clostridium perfringens inhibition by sodium nitrite as a function of pH, inoculum size and heat.

Riham W. E., Jr.; Solberg, M.

Journal of Food Science 40 (3) 439-442 (1975) [13 ref. En] [Dept. of Food Sci., Cook Coll., Rutgers Univ. - St. Univ. of New Jersey, New Brunswick, New Jersey 08903, USA]

The effect of heat, pH, inoculum size and nitrite concn. on the inhibition of various Cl. perfringens strains was characterized. The inhibition of 6 strains in filter sterilized medium was correlated to the amount of undissociated nitrous acid. The same was not true in autoclaved medium where a more potent inhibitor appeared to exist. A 4-log cycle increase in inoculum cell concn. increased nitrite tolerance 5- to 10-fold in filter sterilized medium and 10- to 100-fold in autoclaved medium. The relationship between log inoculum size and log nitrite concn. necessary for inhibition was linear for strain 8797. For every 6.8 min exposure of a nitrite-containing culture medium to heat at 121°C, the inhibitory concn. of nitrite for strain 8797 was diminished by 90%. IFT

92

Clostridium perfringens growth in a nitrite containing defined medium sterilized by heat or filtration.

Riha, W. E., Jr.; Solberg, M.

Journal of Food Science 40 (3) 443-445 (1975) [12 ref. En] [Dept. of Food Sci., Cook Coll., Rutgers Univ. - St. Univ. of New Jersey, New Brunswick, New Jersey 08903, USA]

The growth of Cl. perfringens 8797 in a nitrite-containing chemically defined medium at pH 6.3 was characterized with respect to the method of

medium sterilization and nitrite concn. All cultures which grew in either autoclaved or filter sterilized medium demonstrated equivalent generation times and reached equivalent max. cell concn. regardless of the nitrite concn. A significant difference in adjustment phase duration existed between autoclaved and filter sterilized medium, although within each type of medium the duration of the adjustment phase was homogeneous regardless of the nitrite concn. The effect of nitrite appeared to be cellular and was permanent. IFT

93

[Studies on nitrosamines in foods. I. Contents of nitrate and nitrite in various foods.]

Moon, B. S.; Kim, B. S.; Lee, J. K.; Woo, S. K. *Report of the National Institute of Health* 10, 277-283 (1973) [15 ref. Ko, en] [Dept. of Hygiene, Nat. Inst. of Health, Seoul, Korea]

102 samples of 53 foods were analysed for nitrate and nitrite. Ranges of contents of nitrate and nitrite (ppm), respectively, were: cereals 17.0-26.5, undetected; legumes 1.6-22.5, 0-0.76; vegetables 1.5-140.5, 0-6.0; fruit 5.9-29.0, 0-0.7; fish and shellfish pickles 4.2-17.2, 0-0.8; and meat products 19.8-38.0, 0.3-5.0. Nitrite was not detected in 79 samples. KoSFoST

94

[The effect of nitrates in tomato paste on the uptake of tin by the product.]

Boneva, L. A.; Korolenko, V. A.; Globina, N. N. *Izvestiya Vysshikh Uchebnykh Zavedenii, Pishchevaya Tekhnologiya* No. 6, 44-46 (1974) [1 ref. Ru] [Odesskii Tekhnologicheskii Inst. Pishchevoi Promyshlennosti im. M. V. Lomonosova, USSR]

The effect of the nitrate concn. on the accumulation of Sn in canned tomato paste during storage was studied. Nitrate concn. (as NaNO_3) in the paste were 300-800 mg%. Only traces of nitrites were present. It was determined that the increased can corrosion rate in the presence of nitrates was due to effects on the conductivity of the tomato paste, and depolarization effects. Can corrosion rate increased with increasing nitrate concn., especially in non-lacquered cans. STI

95

[Contents of nitrates, nitrites and nitrosamines in 3 types of cheese, Edam, Gouda and Tilsit.]

Przybyłowski, P.; Kiszka, J.; Dajnowiec, Z. *Przemysł Spożywczy* 29 (1) 9-12 (1975) [16 ref. Pl, ru, en, fr, de] [Inst. Inżynierii i Biotech. Żywności, ART, Olsztyn, Poland]

Contents of nitrates, nitrites and nitrosamines were determined in 141 random samples of cheese supplied at the rate of 2-4/month for 10 months (Nov.-Aug.) by 10 cheese factories. Ranges for nitrates in mg/100 g were respectively: Edam, 0.093 (Nov.)-0.316 (Feb.); Gouda, 0 (June)-0.345 (Jan.); and Tilsit, 0.062 (March)-0.301 (Feb.). Corresponding ranges for nitrites were: Edam, 0

(March)-0.14 (June); Gouda 0 (May, June)-0.118 (July); and Tilsit 0 (March)-0.125 (April). 2nd order regression equations calculated for the 3 cheese varieties indicate nitrate max. in Feb.-April, and corresponding nitrite min. High nitrite values in June-Aug. are ascribed to summer additions of KNO_3 to cheese milk in excess of those prescribed. 31 of the 141 cheese samples gave a positive nitrosamine colour reaction in June-Aug. SKK

96

[Nitrate/nitrite in cheese: toxicology, effect and analysis.]

Brathen, G.

Meieriposten 64 (8) 243-248 (1975) [26 ref. No] [Meierilab., Oslo, Norway]

Although use of nitrates and nitrites in foodstuffs has been prohibited in Norway since 1 Jan. 1973, use of ≤ 15 g KNO_3 /100 l. cheesemilk is still permitted under a special exemption. The author considers various aspects of the nitrates/nitrites problem, in particular the main food sources of nitrates (vegetables) and nitrites (meat products), the formation of nitrosamines, possible alternatives to nitrate for controlling butyric acid fermentation in cheese, the nitrate and nitrite content of the final cheese, and methods of analysis. ADL

97

Fate of nitrate in meat-curing model systems composed of myoglobin, nitrite and ascorbate.

Fujimaki, M.; Emi, M.; Okitani, A.

Agricultural and Biological Chemistry 39 (2) 371-377 (1975) [14 ref. En] [Dept. of Agric. Chem., Univ., Tokyo, Japan]

The fate of nitrite during curing and cooking was investigated with model solutions composed of myoglobin, sodium nitrite and sodium ascorbate at various ratios. All N in nitrite, after curing and cooking, was recovered as residual nitrite (i), nitrate (ii), nitrosyl group of denatured nitrosomyoglobin (iii) and gaseous N compounds (iv). (i), (ii) and (iv) increased when cooking temp. was raised from 70° to 80°C. Almost all nitrite-N was recovered as II whenever greening occurred in the curing period. IV was produced under the condition where both sodium nitrite and sodium ascorbate were abundant as compared with myoglobin, and this reaction proceeded not in the curing period but at the cooking stage. Addition of NaCl into the model system increased (i) and (iii). A possible scheme for the fate of added nitrite is discussed with reference to the results obtained. AS

98

[Conversion of nitrite and nitrate in meat products.

1. Automatic determination of nitrite and nitrate in meat products using the Technicon Autoanalyser.]

Zur Kenntnis Umsetzung von Nitrit und von Nitrat in Fleischwaren. 1. Die automatische Bestimmung von Nitrit und Nitrat in Fleischwaren mit dem Technicon Autoanalyser.

Hauser, E.; Weber, U.

Fleischwirtschaft 55 (4) 547-549 (1975) [3 ref. De, en, fr] [Eidgenössische Veterinärämter, Sektion Lebensmittelchemie, Viktoriastrasse 85, CH-3013 Bern, Switzerland]

An automatic method of determining NO_2^- and NO_3^- in meat products according to Gran and Mirna [Fleisch und Fleischwaren, Parey Verlag 1969, p. 235] is described, using Griess's diazo reaction and photometric determination at 550 nm. A large number of comparative determinations showed no systematic deviation from results obtained by manual methods. RM

99

Studies on the ultimate fate and distribution of nitrite in a cured meat product.

Sebranek, J. G.

Dissertation Abstracts International, B 35 (7) 3381: Order no. 74-19939 (1975) [En] [Wisconsin Univ., Madison 6, Wisconsin, USA]

A ^{15}N tracer technique was employed in an attempt to elucidate reactions in which nitrite takes part during the curing of meat and to gain knowledge on any possibly carcinogenic nitrosamines that might be formed. The stability of nitrite in simple aqueous solutions was studied as well as the proportion of nitrite recovered by the Kjeldahl procedure. The distribution of ^{15}N in cured and canned meat during different heat treatments was followed in the various fractions (water soluble, salt soluble, salt insoluble, gaseous, pigment bound). Residual nitrite decreased and increased tracer appeared mainly in the water soluble and protein bound fractions. The tracer increased by 25-35% in the water soluble fraction, mainly in a compound of an estimated mol. wt. of 130 which proved negative to ninhydrin and a sulphhydryl group reagent and non-inhibiting to the growth of *Clostridium botulinum* types A and B. FSB

100

Effect of sodium nitrite and nitrate on *Clostridium botulinum* growth and toxin production in a summer style sausage.

Christiansen, L. N.; Tompkin, R. B.; Shaparis, A. B.; Johnston, R. W.; Kautter, D. A.

Journal of Food Science 40 (3) 488-490 (1975) [3 ref. En] [Swift & Co., Res. & Development Center, Oak Brook, Illinois 60521, USA]

2 experiments were conducted to determine the growth potential of *Cl. botulinum* in fermented sausage. The first test demonstrated that growth and toxin production did not occur during fermentation. Product stored at 27°C did not become toxic. This may be explained by acid production which occurred with sufficient rapidity to negate any nitrate or nitrite effect. The relative effects of nitrite, dextrose and starter culture on *Cl. botulinum* growth in thuringer stored at 27°C were then evaluated. Growth of *Cl. botulinum* was prevented in sausage formulated with dextrose and $\geq 50 \mu\text{g}$ nitrite/g meat. Average pH of these samples decreased from an initial 5.63 to 4.68 within 1 wk at 27°C. Omitting dextrose from the sausage

formulation resulted in samples in which the pH remained at the initial level throughout storage. In these samples, increased nitrite levels $\leq 150 \mu\text{g/g}$ meat retarded but did not completely prevent toxin production. IFT

101

Effect of added sodium nitrite and sodium nitrate on sensory quality and nitrosamine formation in thuringer sausage.

Dethmers, A. E.; Rock, H.; Fazio, T.; Johnston, R. W.

Journal of Food Science 40 (3) 491-495 (1975) [13 ref. En] [Swift & Co., Res. & Development Center, Oak Brook, Illinois 60521, USA]

The effects of added sodium nitrite and sodium nitrate on sensory qualities and nitrosamine formation in fermented thuringer sausage were investigated. Thuringer was stored under selected temp. and time conditions and tested fresh, fried and baked. Trained sensory panels indicated that flavour and appearance qualities were improved with 50 ppm added nitrite and that desirable flavour and appearance characteristics were obtained with 100 ppm or more added nitrite. Added nitrate produced detectable improvements only in the absence of nitrite. No nitrosamines were detected in thuringer regardless of added nitrite, added nitrate, storage condition, or kitchen preparation method. IFT

102

[The effect of temperature on the dynamics of decomposition of nitrite and on the formation of nitrosomyoglobin in beef.]

Cavlek, B.; Satovic, V.; Matic, S.

Tehnologija Mesa 15 (7/8) 206-211 (1974) [30 ref. Sh, en] [Tehnoloski Fak., Zagreb, Yugoslavia]

Effects of temp. during canning of beef on nitrite decomposition and nitrosomyoglobin formation are discussed. Nitrite decomposition was found to be closely related to nitrosomyoglobin formation, these reactions being enhanced by addition of ascorbic acid. Addition of 10 mg nitrite/100 g meat gave acceptable red coloration of the canned beef. STI

103

Influence of sodium nitrite on the chemical and organoleptic properties of comminuted pork.

Hadden, J. P.; Ockerman, H. W.; Cahill, V. R.; Parrett, N. A.; Borton, R. J.

Journal of Food Science 40 (3) 626-630 (1975) [13 ref. En] [Dept. of Animal Sci., Ohio St. Univ., Columbus, Ohio 43210, USA]

Objectives of a study undertaken to further develop present knowledge of the action of sodium nitrite in meat involved an examination of organoleptic and chemical differences occurring between cooked, canned pork emulsions processed with or without added sodium nitrite in samples with or without added NaCl. It appears that sodium nitrite added to cooked, canned comminuted pork plays a vital role in developing and maintaining

cured pork flavour. Nitrite was found to retard the rate of oxidative rancidity (thiobarbituric acid value) in this model system. However, it is important to note that in the model system studied, spices, sweeteners and extenders were excluded from the formulation and that the average fat level of the finished product was approx. 17% which is leaner than that used in most commercial formulations. IFT

104

Fluorometric determination of sub-nanogram levels of nitrite using 5-aminofluorescein.

Axelrod, H. D.; Engel, N. A.

Analytical Chemistry 47 (6) 922-924 (1975) [5 ref. En] [Nat. Center for Atmospheric Res., Boulder, Colorado 80303, USA]

The measurement of nitrite at extremely low levels is important when studying nitrite reactions in foods. A new procedure for trace nitrite detn., sensitive to 50 pg/ml, makes use of 5-aminofluorescein, which is highly fluorescent and has a primary amino group; the method is quite simple. Fluorescence increases with increasing nitrite concn. AL

105

[The nitrate and nitrite content of industrially-produced baby foods in Norway.]

Reinton, R.

Tidsskrift for Hermetikindustri 60 (10/11) 196-199 (1974) [22 ref. No]

Studies on the nitrite, nitrate and moisture content of 19 samples of bottled or canned foods for infants ≥ 3 months old, 19 samples of bottles or canned foods for infants ≥ 8 months old, 1 sample of dried carrots for babies, and 1 sample of canned spinach (labelled as suitable for babies) are described. The bottled and canned baby foods included various meat and fish products with or without vegetables. Tables of results are given. No nitrite was detected in any sample. 32 of the 40 samples contained ≥ 100 mg nitrate/kg; the canned spinach contained ≥ 1650 mg nitrate/kg; and the dried carrots contained ≤ 26 mg nitrate/kg. AJDW

106

Food Group and Microbiology, Fermentation and Enzyme Technology Group Symposium.

[Conference proceedings]

United Kingdom, Society of Chemical Industry, Food Group; United Kingdom, Society of Chemical United Kingdom, Microbiology, Fermentation & Enzyme Technology Group; UK, Institute of Food Science & Technology

Journal of the Science of Food and Agriculture 26 (3) 379-384 (1975) [En]

Summaries are given of papers presented at this symposium which was held jointly with the Institute of Food Science and Technology in London on 13 March 1975. They are: Naturally occurring nitrate/nitrite in foods, by R. Walker (pp. 379-380, 11 ref.); The contribution of nitrite and nitrate to

the colour and flavour of cured meats, by D. B. MacDougall, D. S. Mottram & D. N. Rhodes (p. 380); The microbiological effects of nitrate and nitrite [in cured meats], by T. A. Roberts (pp. 380-381); The toxicology of nitrate, nitrite and nitrosamines, by P. F. Swann (pp. 381-382); The formation and analysis of N-nitrosamines, by J. K. Foreman & K. Goodhead (pp. 382-383); Formation of C- and S-nitrosation products and their further reactions, by J. Gilbert, M. E. Knowles & D. J. McWeeny (pp. 383-384, 5 ref.); and The analysis of nitrate and nitrite in foodstuffs: a critical review, by C. D. Usher & G. M. Telling (p. 384). JA

107

Influence of different preparation and extraction methods on changes in the content of carbohydrates, amino acids and nitrate of plant fresh and dry matter.

Koch, K.; Hehl, G.

Zeitschrift für Analytische Chemie 273 (3) 203-208 (1975) [19 ref. En, de] [Büntehof Agric. Res. Sta., Bünteweg 8, D-3000 Hannover-Kirchrode, Federal Republic of Germany]

Methods of preparing and extracting plant material were compared in order to find the most suitable method for detn. of NO_3^- , amino acids and carbohydrates. For NO_3^- and amino acid detn., triple extraction of fresh or frozen material ensured quantitative yield. For carbohydrates, air-drying at 60°C and double extraction in ethanol and water gave best results. RM

108

Nitrate and nitrite in spinach (*Spinacia oleracea* L.) as affected by application of different levels of nitrogen fertilizer, blanching, and storage after thawing of frozen product.

Eerola, M.; Varo, P.; Koivistoinen, P.

Acta Agriculturae Scandinavica 24 (3) 286-290 (1974) [17 ref. En] [Inst. of Food Chem. & Tech., (EKT), Univ. of Helsinki, SF-00710 Helsinki 71, Finland]

An increase in N fertilization from 0 to 240 kg N/ha increased the nitrate content to 11-fold in early spinach and to 5-fold in late spinach. Only minor amounts of nitrite were found in fresh spinach. The increase in total N in spinach seemed to be due only to the rise in NO_3^- nitrogen in DM. The nitrate concn. of stalks was more than $3 \times$ that of leaves. The nitrate concn. of spinach was decreased on the average by 62% by water blanching and by 18% by steam blanching, while nitrite rose by about 100% during both types of blanching. In thawed deep-frozen products the nitrite concn. increased very rapidly after a lag period of 2-3 days depending on the storage temp. AS

109

Growth response and nitrate-nitrogen content of soil and spinach when fertilized with different sources and rates of nitrogen.

Brown, J. F.

Dissertation Abstracts International, B 35 (8)
3707: Order No. 75-3576 (1975) [En] [Tennessee Univ., Knoxville, Tennessee 37916, USA]

Trials with fertilizer application to *Spinacia oleracea* L. cultivar Chesapeake indicated that 100 lb N/acre from calcium or ammonium nitrate was near the optimum rate, and that 200 lb N/acre from ammonium nitrate or sulphate, calcium nitrate or S-coated urea may result in excessive levels of nitrate-N in plant tissue, especially in spring. AL

110

Formation of heterocyclic N-nitrosamines from the reaction of nitrite and selected primary diamines and amino acids.

Warthesen, J. J.

Dissertation Abstracts International, B 35 (7)
3382: Order no. 74-29739 (1975) [En] [Oregon St. Univ., Corvallis, Oregon 97331, USA]

The reaction of primary amines with nitrite was investigated with regard to the formation of N-nitrosamines. In low moisture systems at 160°C various primary amine hydrochlorides yielded nitrosamines. Putrescine and cadaverine gave over 20% of nitrosopyrrolidine; ornithine, lysine and butylamine gave various nitrosamines with lesser yields. In aqueous buffered solutions at temp. up to 100°C similar compounds were formed. The reactions are influenced by pH, type of buffer, nitrite concn. and temp.; the reaction rate appears to be second order in respect of nitrite concn. In a system similar to the frying of bacon at 177°C in the presence of 200 ppm nitrite, 109 ppb nitrosopyrrolidine was formed; this figure was trebled if 0.4% putrescine was also added. FSB

111

Wiltshire curing with and without nitrate. I. Vacuum packed sliced back bacon.

Taylor, A. A.; Shaw, B. G.

Journal of Food Technology 10 (2) 157-167 (1975) [11 ref. En] [Meat Res. Inst., Langford, Bristol, UK]

Unsmoked bacon has been made by a factory Wiltshire process incorporating hand pumping and immersion using brines with and without nitrate and with diminishing concn. of nitrite. The quality and stability of the bacon during storage in vacuum packs has been compared. Curing with a nitrate-free brine containing 26% salt and 1000 ppm nitrite produced back bacon with 57-81 ppm nitrite and approx. 4% salt in the lean and this, when sliced and vacuum packed, was still acceptable after 5 wk at 5°C and 2 wk at 15°C. Brines with nitrite concn. of ≤ 500 ppm gave back bacon which was more prone to souring during storage due to increased growth of lactic acid bacteria. AS

112

[The stability of nitrite in meat products.]

Olsman, W. J.

Voeding-middelentechnologie 8 (3) 7-11 (1975) [3 ref. Nl] [Central Inst. voor Voedingsonderzoek, TNO, The Hague, Netherlands]

Disappearance of nitrite from cured meat products (by formation of nitrate, nitrosopigments, NO₂ or protein-bound nitrite) is discussed. Brief details are given of studies on the kinetics of disappearance of nitrite from a luncheon meat-type product during storage; aspects considered include effects of pH, storage temp., the meat, protein and amino acid concn. in the product, the role of thiol groups, and the effects of added EDTA. Tables and graphs of selected results are given. AJDW

113

[Nitrates and nitrites in foods.]

Cantoni, C. A.; Maccapani, M.

Archivio Veterinario Italiano 25 (5/6) 165-169 (1974) [7 ref. It, en, fr] [Istituto di Ispezione degli Alimenti di Origine Animale, Univ. degli Studi di Milano, Italy]

Tables of values are given for the nitrate and nitrite concn. in samples of various foods, including; fresh vegetables; freeze-dried vegetables; meat and vegetable purees for infants; fruit juices; sea-foods; stock cubes; and herbs and spices. The highest nitrate and nitrite concn. were recorded in freeze-dried spinach (2367 mg/kg and 21 mg/kg, respectively). AJDW

114

Effect of sodium chloride and sodium nitrite on the heat resistance of *Staphylococcus aureus* NCTC 10652 in buffer and meat macerate.

Bean, P. G.; Roberts, T. A.

Journal of Food Technology 10 (3) 327-332 (1975) [11 ref. En] [Meat Res. Inst., Langford, Bristol BS18 7DY, UK]

The heat resistance of *Staphylococcus aureus* NCTC 10652 in tris-maleate buffer (pH 7.0) was increased by 4 or 8% (w/v) NaCl (P=0.001). At pH 6.5 the D_{60374C} in both buffer and meat macerate was increased by 8% (w/v) NaCl. Addition of NaNO₂ had little effect on the heat resistance. AS

115

Fluorometric determination of nitrite in cured meats.

Coppola, E. D.; Wickroski, A. F.; Hanna, J. G.

Journal of the Association of Official Analytical Chemists 58 (3) 469-473 (1975) [11 ref. En] [Connecticut Agric. Expt. Sta., 123 Huntington St., New Haven, Connecticut 06504, USA]

An indirect fluorometric method for determining NaNO₂ in meat products is presented. The extracted NaNO₂ is consumed in a diazotization reaction with a measured excess of sulphanilic acid. Fluorescamine, which acts selectively with primary amines such as sulphanilic acid, is a fluorogenic reagent for the excess amine. The amine consumed, calculated by difference from the total originally present, is directly related to the NaNO₂ content of the sample. Interferences from amino acids and soluble proteins in the meat extract are eliminated by judicious use of a secondary peak in the fluorescence spectra (436 nm excitation, 495 nm

fluorescence) combined with measurement at low pH (3.30). The recoveries of NaNO_2 ranged from 83.2 to 99.6% with an average of 93.4% and a SD of $\pm 5.28\%$ for 11 determinations. AS

116

[Nitrite changes in canned meat.]

Cantoni, C.; Cattaneo, P.; Cipolla, M.; Calcinardi, C.

Industria Alimentari 14 (5) 87-90 (1975) [17 ref. It, en] [Istituto de Ispezione degli Alimenti di Origine Animale, Univ., Milan, Italy]

0, 150, 300, 600, 1200 or 2400 mg NaNO_2/kg were added to minced beef, and 200 g samples were sterilized in cans. Values are tabulated for contents (in meat and jelly) of SH groups, free nitrites, nitrates, NO bound to myoglobins and myofibrils, NH_3 , and total volatile basic N. It is concluded that free nitrite contents never exceeded the prescribed max. limits (max. found at 2400 mg/kg addition, 36 mg/kg in meat and 11.1 mg/kg in jelly) and that for colour preservation, ≤ 150 mg NaNO_2/kg (legal max.) was best. SKK

117

[Colorimetric determination of nitrite and nitrate in meat products and fish sausage.]

Mihashi, Y.; Tatsumi, M.

Annual Report of the Tokyo College of Pharmacy [Tokyo Yakka Daigaku Kenkyu Nenpo] 23, 299-305, 362 (1973) [13 ref. Ja, en]

A sensitive method for detn. of nitrite and nitrate in fish sausage and meat products is described. Nitrite is reacted with p-nitroaniline to form a diazonium ion, which is coupled to α -naphthylamine to form a pink azo dye; the absorbance of the resulting solution is determined at 500 nm. Nitrate does not interfere. Nitrate may be determined after quantitative reduction to nitrite by Cd. Factors influencing recovery and accuracy are discussed. Data are given for sodium nitrite concn. in ham, pressed ham, sausage and fish sausage; ranges (with number of samples in parentheses) were (mg%): ham (5) 3.9-5.4; pressed ham (2) 3.1-3.4; sausage (5) 4.1-4.5; and fish sausage (4) 2.5-4.8. [From En summ.] AJDW

118

An *Escherichia coli* strain for use in nitrate analysis.

Lowe, R. H.; Gillespie, M. C.

Journal of Agricultural and Food Chemistry 23 (4) 783-785 (1975) [4 ref. En] [Agric. Sci. Center, Agronomy Dept., Univ. of Kentucky, Lexington, Kentucky 40506, USA]

119

Nitrates in Kansas groundwaters as related to animal and human health.

Ridder, W. E.; Oehme, F. W.; Kelley, D. C.

Toxicology 2 (4) 397-405 (1974) [55 ref. En] [Dept. of Infectious Diseases, Kansas St. Univ., Manhattan, Kansas 66506, USA]

Nitrate concn. in water from 88 wells on Kansas farms with waters high in nitrates ranged from 6 to

1200 ppm. This high level appeared to be related to improper location and construction of the wells.

Although the presence of animal and human health problems did not correlate with the nitrate levels in well water and the use of inorganic fertilizers, the many variables made evaluation difficult. AL

120

Nitrate accumulation in greenhouse vegetable crops

Cantliffe, D. J.; Phatak, S. C.

Canadian Journal of Plant Science 54 (4) 783-788 (1974) [12 ref. En, fr] [Ontario Min. of Agric. & Food, Horticultural Expt. Sta., Simcoe, Ontario N3Y 4L1, Canada]

4 cultivars each of lettuce (*Lactuca sativa* L.), radish (*Raphanus sativa* L.) and spinach (*Spinacia oleracea* L.) were grown at three NH_4NO_3 levels (0, 14.7 and 29.4 g N/m²) in a muck soil as a commercial greenhouse crop under winter conditions (low light intensity and short photoperiod). Analysis of the tissues for $\text{NO}_3\text{-N}$ showed that all 3 crops contained high concn. of $\text{NO}_3\text{-N}$ when grown under these conditions: radish>lettuce>spinach. Total N and $\text{NO}_3\text{-N}$ were increased by N fertilizer only in radish roots, and yield was promoted by the additional N only in lettuce. Lettuce cultivars Domineer and Korrekt contained significantly less NO_3 than Grand Rapids or Noran and were higher yielding than the standard cultivar Grand Rapids. The NO_3 content of radishes was extremely high, especially in the root of the white cultivar Icicle (1.68% $\text{NO}_3\text{-N}$). Yield of roots from Icicle was not significantly different from Champion, Early Scarlet Globe and Red Boy, cultivars which did not contain as much $\text{NO}_3\text{-N}$. Smooth-leaf spinach cultivar Northland was higher yielding with significantly less NO_3 than savoyed cultivars America, Winter Bloomsdale or Savoy. High NO_3 tissue concn. can be reduced in these crops by growing cultivars that accumulate less NO_3 . AS

121

[The nitrate content of vegetables.] [Lecture]

Jensen, P. T.

pp. 179-180 (1974) [Da]

Brief details are given of studies on the nitrate content of vegetables; nitrate concn. were determined (i) by reduction of nitrate to NH_3 by means of Devarda's alloy (without separation of protein from the vegetable homogenate) and subsequent separation of the NH_3 by distillation and its determination by titration; (ii) as (i), but after removal of protein from the vegetable homogenate by precipitation; and (iii) by a xlenol method. A table of values is given for the nitrate contents (determined by the above 3 methods) in lettuce, mushrooms, chicory, cress, tomatoes, white cabbage, red cabbage, potatoes, Brussels sprouts, cucumbers, celery, carrots, leeks, spinach and apples. Method (i) generally gave the highest and method (iii) the lowest values. Of the samples studied, the highest nitrate concn. were recorded in lettuce and celery. [See 7 12S1671]. AJDW

122

[Nitrates and nitrites in foods of animal origin.]

[Lecture]

Nordal, J.

pp. 181-182 (1974) [10 ref. No] [Inst. for
Naeringsmiddelhygiene, Postboks 8146, Oslo-Dep.,
Oslo 1, Norway]

The use of nitrates and nitrites in cured meat products is discussed, with reference to: formation of the typical 'cured' colour; flavour and aroma development; and control of growth of *Clostridium botulinum*. [See [See 7 12S1671.] AJDW

123

The reduction of added sodium nitrate and nitrite in poultry meat curing.

Sharma, N.

Indian Poultry Gazette 58 (2) 102-106 (1974)

[11 ref. En] [Div. of Poultry Res., Indian Vet.
Res. Inst., Izatnagar, Uttar Pradesh, India]

25 birds aged 6-9 months were used to study the amount of nitrite present in the tissues of untreated, cured, and cured smoked chickens after 0, 4 and 8 days storage at (i) room temp. (25-26°C) or (ii) refrigeration temp. (5-6°C). The curing solution contained 5.44 kg NaCl, 2.72 kg cane sugar, 85 g sodium nitrate, 112 g sodium nitrite and 20 g monosodium glutamate, all dissolved in 40 l. mineral-free water. There was no nitrite in fresh chilled chicken; after 72 h of curing treatment at 5°C the nitrite content was 281 ppm. Nitrite concn. in stored samples were, for (i) and (ii) respectively: 347 and 395 ppm after 4 days storage; not given (spoiled on 5th day) and 256 ppm at 8 days; and not given and 114 ppm after pressure cooking on the 8th day. After smoking at 40°C for 4 h in hardwood smoke the corresponding amounts were: 225 ppm at 0 days; 240 and 281 ppm at 4 days; 152 and 188 ppm at 8 days; and 23 and 27 ppm after cooking. The dark meat had a higher nitrite content than white meat. AL

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FAB 48

NITRATES AND NITRITES IN MEAT PRODUCTS

SELECTED FROM VOLUME 8

FOOD SCIENCE AND TECHNOLOGY ABSTRACTS

under the direction of

Commonwealth Agricultural Bureaux, Farnham Royal, Bucks; Institut für Dokumentationswesen, Frankfurt am Main; Institute of Food Technologists, Chicago; Centrum voor Landbouwpublikaties en Landbouwdocumentatie (Pudoc), Wageningen; Zentralstelle für maschinelle Dokumentation—Frankfurt am Main.

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H. BROOKES

ASSISTANT EDITOR

1

[Experimental application of an ion-selective electrode for determination of nitrate in hygienic analysis of water.]

Nowak, K.; Luczak, J.

Roczniki Panstwowego Zakladu Higieny 26 (3) 401-405 (1975) [6 ref. Pl, ru, en] [Zaklad Higieny Komunalnej Panstwowego Zakladu Higieny, Warsaw, Poland]

Comparative investigations were carried out on the detn. of nitrate N in water by the colorimetric method and with an ion-selective nitrate electrode. Results of measurements by the 2 methods agreed most with nitrate N contents >1.00 mg/l. This concn. is of particular interest for the hygienist concerned with the problem of public health. The electrode method in therefore considered suitable for this purpose. AS

2

In vivo formation of nitroso compounds. I. Changes of nitrite and nitrate concentrations in human saliva after ingestion of salted Chinese cabbage.

Harada, M.; Ishiwata, H.; Nakamura, Y.; Tanimura, A.; Ishidate, M.

Journal of the Food Hygienic Society of Japan [Shokuhin Eiseigaku Zasshi] 16 (1) 11-18 (1975) [23 ref. En] [Nat. Inst. of Hyg. Sci., 18-1 Kamiyoga 1-chome, Setagaya-ku, Tokyo, Japan]

The relationship between dietary nitrate intake and nitrite detected in human saliva was studied. When 200 g of salted Chinese cabbage was taken, the average concn. of nitrite and nitrate in saliva increased to 72 and 545 ppm respectively, whereas with the basal diet their concn. were 12 and 77 ppm, respectively. It was assumed that nitrite in saliva was formed in vivo by the reduction of nitrate. [See also following abstr.] TM

3

In vivo formation of nitroso compounds. II. Changes of nitrite and nitrate concentrations in human saliva after ingestion of vegetables or sodium nitrate.

Ishiwata, H.; Boriboon, P.; Nakamura, Y.; Harada, M.; Tanimura, A.; Ishidate, M.

Journal of the Food Hygienic Society of Japan [Shokuhin Eiseigaku Zasshi] 16 (1) 19-24 (1975) [4 ref. En] [Nat. Inst. Hyg. Sci. 18-1, Kamiyoga 1-chome, Setagaya-ku, Tokyo, Japan]

The intake of such vegetables as lettuce, spinach and dried radish produced a similar increase of nitroso compounds in saliva to that observed with Chinese cabbage. [See preceding abstr.] The increase of nitrite in saliva was further confirmed by use of reagents for nitroso compounds. TM

4

Nitrate levels in farm water and raw milk in the Waikato Region.

Joerin, M. M.; Bowering, A. F.

New Zealand Journal of Dairy Science and Technology 10 (1) 19-20 (1975) [14 ref. En] [Nat. Dairy Lab., Hamilton, New Zealand]

Most dairy farms in this area have their own bore holes. A sample of farm water and bulk milk was taken from each of 20 farms near Hamilton. Nitrate averaged $9 \mu\text{g}$ nitrate-N/100 ml milk (range 0.21) and $133 \mu\text{g}$ nitrate-N/100 ml water (range 0-940). Nitrite was found at 1.0 and $1.4 \mu\text{g}$ nitrite-N/100 ml in milk from 2 farms. JMD

5

The MRI looks at nitrite and bacon. I.

Anon.

Institute of Meat Bulletin No. 87, 31-32 (1975) [En]

A brief summary is given of studies on the nitrite concn. required in brines for curing of bacon. The results show that nitrite concn. ≥ 500 ppm were required to avoid grey non-cured patches in the centre of sides of pork; no further effects of nitrite concn. in the range 500-2000 ppm on bacon colour were observed. The bacon became opaque during storage under illuminated or non-illuminated conditions, resulting in an apparent lightening of the colour. Oxidation of the red pigment at the edge of the eye muscle occurred; this disappeared after vacuum packaging. For acceptable shelf-life and microbiological stability, curing in brine containing ≥ 1000 ppm nitrite was necessary; this resulted in a nitrite concn. >50 ppm in the bacon. Addition of nitrate increased storage stability only slightly. Low counts of food-poisoning bacteria (including clostridia) were detected in fresh bacon. AJDW

6

[Stability of nitroso derivatives (nitrosothiols, nitrosophenols, nitrosohaemoglobin) at alkaline pH.]

Cantoni, C.; Bianchi, M. A.; Beretta, G.

Industria Alimentari 14 (7/8) 79-81 (1975) [16 ref. It, en] [Istituto di Ispezione degli Alimenti di Origine Animale, Univ. degli Studi, Milan, Italy]

Studies on the stability of nitrosocysteine, nitrosoglutathione, nitrosophenol and nitrosohaemoglobin held for ≤ 48 h at 5° or 37°C in tris/HCl buffer at pH 7, 7.5, 8, 8.5 or 9 are described; a table of values is given for the quantity of NO^- released from each compound at each temp. and pH studied. At 37°C , decomposition of nitrosocysteine and nitrosoglutathione occurred; pH had no clear effect on the extent of decomposition, except that decomposition of nitrosoglutathione at pH 9 was markedly greater than at the other pH studied. No decomposition of nitrosophenol or nitrosohaemoglobin was observed at 37°C , and no decomposition of any of the nitroso derivatives studied was observed at 5°C . These results are discussed in relation to decomposition of

nitroso compounds in the human intestine, and consequent implications for the safety of nitrite-containing foods. AJDW

7

Nitrate and nitrite in food.

Morton, I. D.

Nutrition and Food Science No. 40, 8-9 (1975) [2 ref. En]

The use of nitrates and nitrites for curing of fish and meat products is discussed, with reference to control of growth and toxin formation by *Clostridium botulinum*. Nitrate and nitrite levels in crops, well water, canned foods, bacon and saliva are discussed. The breakdown of nitrates to nitrites and the possible health hazard from nitrates and nitrites in the diet are also outlined. Nitrosamines, which have been reported in a variety of foods including cheese, fish meal, flour and cured meat, are still under investigation. GL

8

Nitrate determination in baby food, using the nitrate ion selective electrode.

Pfeiffer, S. L.; Smith, J.

Journal of the Association of Official Analytical Chemists 58 (5) 915-919 (1975) [5 ref. En] [Cent. Res. Div., Gerber Products Co., Fremont, Michigan 49412, USA]

The nitrate electrode has been utilized in the detn. of nitrate content in baby foods (fruit, vegetables, formulated foods and meat). The AOAC xylenol method was employed for comparative results. A reasonable correlation ($r = 0.91$) was found between the 2 methods in the analysis of 49 samples containing 30-350 ppm nitrate. At the average nitrate content (100 ppm) of these foods, the standard error was 4.3 ppm. The electrode responds directly to the ionic activity of the nitrate ion. It has a linear concn. range of 1-6000 ppm nitrate and can be used over a wide pH range. The electrode does respond to some extent to anions other than nitrate, and some interferences do occur. These interferences are easily controlled by the use of cation exchange resins. The Corning known addition (spiking) method is used on all samples to insure correct electrode response in solutions containing variable background ionic composition. The electrode has the advantage of simplicity, speed, reproducibility, and accuracy. Work time saved using the electrode as opposed to the xylenol method is about 7 h for the analysis of 20 samples. Error, and the need for repeating analysis, is much less frequent. AS

9

[Simultaneous automatic photometric determination of sulphate and nitrate in drinking, river and drainage water.] Automatische photometrische Simultanbestimmung von Sulfat und Nitrat in Trink-, Fluss- und Dränwasser.

Holz, F.

Landwirtschaftliche Forschung Sonderheft 28/1, 189-201 (1973) [37 ref. De] [Ruhr-Stickstoff

AG, Landwirtschaftliche Forschung Hanninghof, Dülmen/Westfalia, Federal Republic of Germany]

The trisodium salt of 4,5-dihydroxy-3-[(p-sulphophenyl)-azo]-naphthalene-2,7-disulphonic acid forms with Th ions a violet coloured chelate; the colour is discharged by sulphate ions which form colourless complexes with Th. In the method described, sulphate determination is based on reduction in the extinction value of the chelate at 580 nm, interference by Fe and phosphate being removed by pre-treatment with a Be-piperazine buffer. Nitrate is determined by the indirect Re procedure of Holz [*Landwirtschaftliche Forschung* (1970) 23, 23]. Both determinations are carried out simultaneously using a Technicon-Auto-Analyzer. The procedure is described in detail. Good agreement was obtained with results of standard manual methods. SKK

10

[Nitrate content of cows' milk.]

Remond, B.

Lait 55 (547) 390-395 (1975) [16 ref. Fr, en] [Lab. de la Production Laitiere, CRZV de Theix, 63110 Beaumont, France]

This review discusses the normal level of nitrate in milk, as determined in various studies, and the effect of rations with a high nitrate content. It is pointed out that even where cows' health was affected by massive nitrate ingestion, the level in milk was only 15 ppm, well below the max. of 44 ppm permitted in drinking water under the French Public Health Code. A physiological explanation is given for the low levels of nitrate in milk (conversion to nitrite and then ammonia in the rumen; and difficulty of passing the blood-milk barrier). Nitrite levels in milk are also briefly discussed. ADL

11

The influence of dietary nitrate on nitrate concentration in egg yolk and albumen.

Lee, H. W.; Adams, A. W.; Cunningham, F. E. *Poultry Science* 54 (2) 475-478 (1975) [28 ref. En] [Dep. of Dairy & Poultry Sci., Kansas State Univ., Manhattan, Kansas 66506, USA]

Sodium nitrate (0-2000 ppm) was added to the drinking water of 32-wk old SC White Leghorn pullets. Eggs collected once a wk for 8 wk were analysed for nitrate content. Increasing levels of nitrate in the drinking water resulted in increasing levels of nitrate in albumen and yolk. Higher levels of nitrate were found in the yolk than in the albumen. When birds were started on the experiment, nitrate in the drinking water was reflected by immediate increases in nitrate content of the eggs. The nitrate content of eggs from birds receiving 1000 ppm NaNO_3 (728 ppm NO_3^-) exceeded the 45 ppm permissible level of nitrate in drinking water for human beings. AS

12

Filter paper as a source of error in the determination of nitrite in meat.

Fiddler, R. N.; Gentilcore, K. M.

Journal of the Association of Official Analytical Chemists 58 (5) 1069-1070 (1975) [2 ref. En] [E. Regional Res. Cent., ARS, USDA, Philadelphia, Pennsylvania 19118, USA]

Samples of filter paper were found which contain sufficient nitrite to cause significant error in determining the nitrite content of cured meat products by the official AOAC method. 6 of 28 boxes of filter paper examined were contaminated with nitrite. All 6 contaminated boxes were the same brand and grade. These samples of filter paper could contribute from 4.6 to 18.4 ppm nitrite to the amount of nitrite analysed for in meat. AS

13

Variables affecting botulinum toxin development and nitrosamine formation in fermented sausages. [Lecture]

Kueper, T. V.; Trelease, R. D.

Proceedings of the Meat Industry Research Conference pp. 69-74 (1974) [En] [Swift & Co., Oak Brook, Illinois 60521, USA]

Studies on factors influencing growth and toxin formation by *Clostridium botulinum*, organoleptic properties, residual nitrite concn. and nitrosamine formation in fermented sausages are briefly described. Variables studied included: nitrite concn. (≤ 300 ppm); nitrate concn. (≤ 1500 ppm); fermentation temp. (50° or 90°F); inoculum level ($\leq 10\,000$ spores/g); pH (5.6 or 5.2); storage conditions ($\leq 80^\circ\text{F}$ for ≤ 3 months); presence or absence of glucose; and use or non-use of a starter culture. Tables of results are given. The results show that: nitrite controlled toxin formation in non-fermented sausages; no toxin was formed in fermented sausages, even in the absence of nitrite; NaNO_2 markedly improves the flavour and appearance of fermented sausage (NaNO_3 also improves flavour and appearance, but to a lesser extent); nitrite disappears rapidly from fermented sausages, but is generated from nitrate during prolonged high-temp. storage. No nitrosamines were detected in any sample. [See 8 2S132.]

AJDW

14

Formation of ethylnitrolic acid by the reaction of sorbic acid with sodium nitrite.

Namiki, M.; Kada, T.

Agricultural and Biological Chemistry 39 (6) 1335-1336 (1975) [4 ref. En] [Dept. of Food Sci. & Tech., Fac. of Agric., Nagoya Univ., Nagoya, Japan]

Reaction products, particularly ethylnitrolic acid, which are formed by heating sorbic acid with sodium nitrite, were tested for antimicrobial activity in fish meat products e.g. fish sausages. A solution of 0.5 M sodium nitrite was added to a partially suspended solution of 0.5 M sorbic acid and heated in a water bath at 90°C for 1 h. The reaction mixture was extracted several times. Each of the extracts was concn. in vacuo and identified by TLC

on silica gel. Extracts of the TLC bands were used for a growth inhibition activity test using *Escherichia coli* B-110 as the test organism. Ethylnitrolic acid, sorbic acid and sodium nitrite were effective antimicrobial agents at concn. of 0.025-0.05, 2-4 and 1.5-3 mg/ml, respectively. As these results were obtained under special in vitro experimental conditions, it does not necessarily mean that ethylnitrolic acid is actually found in foods containing both sorbic acid and sodium nitrite. GL

15

Absence of nitroso formation from [^{14}C]methomyl and sodium nitrite under simulated stomach conditions.

Han, J. C.-Y.

Journal of Agricultural and Food Chemistry 23 (5) 892-896 (1975) [7 ref. En] [Biochem. Dep., Exp. Sta., E. I. du Pont de Nemours & Co. Inc., Wilmington, Delaware 19898, USA]

16

[Dietary nitrites and nitrosation of phenolic compounds.]

Cantoni, C.; Bianchi, M. A.; Beretta, G.

Industria Alimentari 13 (11) 118-122 (1974) [16 ref. It, en] [Istituto di Ispezione degli Alimenti di Origine Anim., Univ. di Milano, Milan, Italy]

The probable formation of carcinogenic nitrosamines in the human stomach from reaction of ingested nitrites and amines was subjected to critical scrutiny. Examination of the reaction rates of NO_2^- with phenolic and -SH compounds and amines, and the relative abundance of phenolic compounds in foods of vegetable origin, prepared dishes and complete meals suggested that no NO_2^- would be available for nitrosamine formation; reaction rate of NO_2^- with phenol was 10^4 times higher than that with dimethylamine. The concn. of phenolic groups in the diet was 30-2140 mg/100 g DM and was increased 2-3 times by peptic digestion. Model experiments showed that -SH compounds (e.g. glutathione) reacted even more quickly with NO_2^- than phenols. RM

17

[Biological and eco-toxicological problems of aerial application of phenoxyacetic acid derivatives to forests.] Biologische und öko-toxikologische Probleme bei einer Flug-Begiftung unserer Wälder mit Derivaten der Phenoxyessigsäure. [Lecture] Wellenstein, G.

Qualitas Plantarum - Plant Foods for Human Nutrition 25 (1) 1-20 (1975) [many ref. De, en] [Lettenweg 18, D78 Freiburg, Federal Republic of Germany]

Problems of residue accumulation in berries, edible fungi, honey and game in forests sprayed with 2,4,5-T and similar herbicides are discussed on the basis of literature data; tables and graphs are given showing 2,4,5-T concn. in various berries, edible fungi, game, etc. Effects of herbicides on nitrate concn. in edible plants are also discussed. AJDW

18

Relative significance of dietary sources of nitrate and nitrite. [Review]

White, J. W., Jr.

Journal of Agricultural and Food Chemistry 23 (5) 886-891 (1975) [34 ref. En] [USDA, E, Regional Res. Cent., Philadelphia, Pennsylvania 19118, USA]

In order to provide some perspective on amounts of nitrate and nitrite in our diet, a calculation was made to evaluate the relative contribution of various known sources of nitrate and nitrite. Combining estimates of per capita consumption of various categories of food and drink with average values for nitrate and nitrite content of these diet components has made it possible to attribute the nitrate and nitrite intake of the average US inhabitant to major dietary categories. It is estimated that four-fifths of nitrate intake is from vegetables, and less than one-sixth from cured meats. Other sources (fruits, milk products, water, bread) are not significant. Two-thirds of the nitrate entering the average stomach originates in saliva and slightly less than one-third comes from cured meats. Other sources of nitrite are not significant. AS

19

Analysis for aqueous nitrates and nitrites and gaseous oxides of nitrogen by electron capture gas chromatography.

Ross, W. D.; Buttler, G. W.; Duffy, T. G.; Rehg, W. R.; Winingar, M. T.; Sievers, R. E.

Journal of Chromatography 112, 719-727 (1975) [7 ref. En] [Monsanto Res. Corp., Dayton Lab., St. B Box 8, Dayton, Ohio 45407, USA]

A highly sensitive gas chromatographic method is presented for the detn. of aqueous nitrates. By suitable chemical pretreatment, this method is also applicable to the analysis of aqueous nitrites and gaseous oxides of N. The method has been applied to the analysis of drinking water, etc. The technique involves the conversion of the nitrate ion to nitrobenzene with subsequent analysis by electron capture gas chromatography. The detection limit for nitrobenzene is about 10^{-12} g, making possible the analysis of environmentally significant concn. of aqueous nitrates and nitrites and gaseous oxides of N. AS

20

[Significance of nitrates in drinking water.]

Livshits, L. L.; Kokina, A. G.; Lazyuk, G. I.

Gigiena i Sanitariya No. 5, 103-104 (1975) [Ru] [Belorusskii Nauchno-issled. Sanit.-gigienicheskii Inst., Minsk, USSR]

Within the framework of studies into the potential dangers of high levels of nitrates in drinking water on the unborn human foetus, the nitrate levels of drinking water from (i) 378 artesian wells and (ii) 720 deep wells were determined. 366 of (i) had nitrate levels (as mg N/l.) of ≤ 10 , and the remaining 12 had 10.1-40; 142 of (ii) had ≤ 10 , 276 had 10.1-20, 214 had 20.1-40, 71 had 40.1-100 and the remaining 17 had >100 . The conclusion was that the nitrate level was not a health hazard to the foetus. HBr

21

[Chemical characteristics of "artificial wines".]

Amati, A.; Minguzzi, A.; Pallotta, U.

Scienza e Tecnologia degli Alimenti 5 (3) 177-182 (1975) [31 ref. It, en] [Istituto di Ind. Agrarie, Servizio Vigilanza Repressione Frodi, Bologna, Italy]

Differences in composition between genuine Albana, Sangiovese and Trebbiano wines, and artificial "musts" and "wines" produced by fermentation of by-products (10-40% lees, virgin or fermented pomaces, 20-40% press-wines) with added water and sugar were examined. Complete analysis of the various products revealed the following major differences between the artificial and the 3 genuine wines; malic acid, 0.38-0.98 vs. 3.0, 2.07 and 3.50 g/l.; proline, 82.7-201.3 vs. 600, 960 and 590 mg/l.; nitrate (as N_2O_2), 22.5-56.3 (in "musts") and 28.8-39.9 (in "wines", although 2 isolated results were as low as 1.8 and 3.2) vs. 1.0, 3.0 and 4.0 mg/l. in genuine wines. The high nitrate content of the artificial products was attributable to the high nitrate content in the water used. Significant differences were also found in concn. of polyphenols, alkaline and alkaline earth metals and citric acid. RM

22

[Reduction of residual nitrite in boiled sausages.]

Pal'min, V. V.; Prizenko, V. K.; Fedorova, G. A. *Voprosy Pitaniya* No. 4, 58-59 (1975) [7 ref. Ru, en] [Moskovskii Tekh. Inst. Myasnoi i Molochnoi Promyshlennosti, Moscow, USSR]

A new method of colour enhancement in meat which enables the formation of residual nitrite and nitrosamines to be eliminated is described. The method is based on incorporation of the disodium salt of haematin chloride (DSHC) in conjunction with sodium ascorbate. Sausage meat, prepared by comminuting beef and semifat pork, was divided into 2 portions. The (i) control was salted as normal (2.0% NaCl and 7.5 mg% nitrite) and (ii) the experimental portion received only salt (2.0%). After 48 h, the meat was mixed; to (ii) was added 3.0 or 5.0 mg% DSHC, 0.05% sodium ascorbate and 3.0 or 5.0 mg% sodium nitrite; both (i) and (ii) received normal flavourings. The sausages were then processed by the standard procedure, and were analysed for colour (modified Hornsey method) and residual nitrite (diazotization with protein precipitation). Addition of sodium ascorbate, particularly with DSHC, enhanced the colour. No residual nitrite was found in any samples made with DSHC + 3.0 mg% nitrite and only 0.5-0.65% in samples with DSHC + 5.0% nitrite (vs. 3.3% in the control). The optimum level of addition is considered to be 3.0% DSHC, 0.05% sodium ascorbate, 3.0 mg% sodium nitrite and 2.5% NaCl. HBr

23

Persistence of echovirus and poliovirus in fermented sausages. Effects of sodium nitrite and processing variables.

Kantor, M. A.; Potter, N. N.

Journal of Food Science 40 (5) 968-972 (1975) [24 ref. En] [Dep. of Food Sci., Cornell Univ., Ithaca, New York 14853, USA]

Dry and semi-dry varieties of fermented sausage inoculated with high titres of poliovirus and echovirus were prepared. The sausages contained sodium nitrite at added levels of 150.0, 75.0, 37.5 and 0 ppm. The commercial operations of fermentation, heating and drying were estimated, and aliquots of meat were analysed at various intervals for virus titre, bacterial plate counts, moisture, pH and residual nitrite. Except for a loss of about 90% in cervelat after heating, both viruses persisted in high titres and were virtually unaffected by any level of nitrite and by the wide range of processing conditions employed. IFT

24

Effect of nitrate and nitrite on color and flavor of country-style hams.

Eakes, B. D.; Blumer, T. N.; Monroe, R. J.

Journal of Food Science 40 (5) 973-976 (1975) [37 ref. En] [Dep. of Food Sci., N. Carolina State Univ., Raleigh, N. Carolina 27607, USA]

Country-style hams were produced with and without nitrate and nitrite by dry curing and brine pumping methods. Evaluations of chemical characteristics, colour, flavour and residual nitrate and nitrite were made after 30, 60, 90 and 100 days of processing. Moisture decreased while salt and fat increased over processing time, but treatment effects were similar. Hams cured with nitrate and nitrite either alone or in combination had more acceptable colour than hams cured with salt and sucrose only. Aged flavour development was not significantly affected by curing treatment. Nitrite was depleted after 30 days at 4°C and nitrate gradually decreased with days in storage. IFT

25

Effect of various levels of potassium nitrate and sodium nitrite on color and flavor of cured loins and country-style hams.

Eakes, B. D.; Blumer, T. N.

Journal of Food Science 40 (5) 977-980 (1975) [16 ref. En] [Dep. of Food Sci., N. Carolina State Univ., Raleigh, N. Carolina 27607, USA]

Hams and loins were dry cured with and without nitrate and nitrite at various levels. Added concn. ranged from 0 to 130 ppm in the loins and 70 to 160 ppm in the hams. Colour development of loins cured 16 days without nitrate or nitrite was unacceptable; however, nitrate and nitrite either alone or in combination at 70 ppm resulted in adequate colour development. Hams processed for 90 days and containing 70 ppm of nitrate and/or nitrite also had acceptable colour. Aged flavour of the hams was not affected by the level of nitrate and nitrite. Nitrite was depleted at sampling and nitrate was slightly reduced. IFT

26

Analysis of nitrate and nitrite in foodstuffs: a critical review. [Lecture]

Usher, C. D.; Telling, G. M.

Journal of the Science of Food and Agriculture 26 (11) 1793-1805 (1975) [52 ref. En] [Unilever Res. Lab., Colworth House, Sharnbrook, MK44 1LQ, UK]

A general review is presented of published methods for determination of nitrate and nitrite levels in foodstuffs especially meat. Published methods show wide variations in techniques for extraction, clean-up (clearing) of extracts and final determinative steps and these are critically compared. The effect of interferences due to the presence of ascorbate, sulphite and phosphate together with formation of a 'meat blank' when nitrate is reduced to nitrite with spongy Cd are discussed. Newer techniques based on the use of ion selective electrodes and automated techniques are outlined and application of techniques such as amperometry, liquid chromatography, ion exchange and spectrophotometry are listed. AS

27

Naturally occurring nitrate/nitrite in foods.

[Lecture]

Walker, R.

Journal of the Science of Food and Agriculture 26 (11) 1735-1742 (1975) [43 ref. En] [Dep. of Biochem., Univ. of Surrey, Guildford, GU2 5XH, UK]

28

Inhibitor of *Clostridium perfringens* formed by heating sodium nitrite in a chemically defined medium.

Moran, D. M.; Tannenbaum, S. R.; Archer, M. C. *Applied Microbiology* 30 (5) 838-843 (1975) [19 ref. En] [Dep. of Nutr. & Food Sci., Massachusetts Inst. of Tech., Cambridge, Massachusetts 02139, USA]

29

The toxicology of nitrate, nitrite and N-nitroso compounds. [Lecture]

Swann, P. F.

Journal of the Science of Food and Agriculture 26 (11) 1761-1770 (1975) [78 ref. En] [Courtauld Inst. of Biochem., Middlesex Hospital Med. School, London W1P 5PR, UK]

Nitrate is essentially non-toxic to mammals but can be reduced to nitrite, e.g. in improperly stored food, by the microflora of the human mouth. Nitrite presents a toxic hazard both because of its direct toxicity and by formation of carcinogenic N-nitroso-compounds by reaction with amino compounds. Administration of toxic amounts of nitrite induces methaemoglobinaemia. The carcinogenic properties of N-nitroso compounds are described. Assessment of the significance to man of

N-nitroso compounds depends upon interpretation of animal experiments and their extrapolation to man. This extrapolation would be more certain if there were a more clear understanding of the factors determining tissue selectivity by carcinogens and tissue sensitivity, and of the mechanism of cumulation of carcinogenic doses and of synergism between carcinogens. Recent experiments suggest that there may soon be a significant breakthrough in the understanding of this. These experiments are briefly discussed. AS

30

Formation of C- and S-nitroso compounds and their further reactions. [Lecture]

Gilbert, J.; Knowles, M. E.; McWeeny, D. J. *Journal of the Science of Food and Agriculture* 26 (11) 1785-1791 (1975) [19 ref. En] [Min. of Agric., Fisheries and Food, Food Sci. Div., Colney Lane, Norwich NR4 7UA, UK]

The possible involvement of nitrite in C- and S-nitrosation reactions with either food components or food additives is reviewed. C-nitrosation of phenols has been shown to occur in smoked bacons with the formation of trace amounts of nitrophenols, and protein-nitrite interactions have been studied under simulated stomach conditions where 3 products were identified. Also some theoretically possible reactions of nitrite with the activated methylene groups of creatinine and ketones are considered. The implication of reaction with sulphhydryl groups of meat proteins with loss of nitrite in meat products and of the potential formation of S-nitrosothiols is discussed with reference to current literature. AS

31

Studies on the accumulation of nitrate in tomato fruit for canning.

Miyazaki, M. *Scientia Horticulturae* 3 (2) 109-128 (1975) [44 ref. En] [Toyo Inst. of Food Tech., Kawanishi, Hyogo, Japan]

Factors influencing NO_3^- accumulation in tomatoes and preventive measures for dissolved Sn caused by NO_3^- in canned tomato juice were investigated. N, K and Ca fertilizers, plant growth regulators, cultivar variation and light intensity were found to affect NO_3^- accumulation. Results are tabulated and graphically presented. In order to obtain fruit with <3 ppm NO_3^- , low NO_3^- cultivars should be grown with Ca fertilizer and a slow-acting N fertilizer. Fruit grown under these conditions were processed into tomato juice, canned in plain cans and the contents of Sn, NO_3^- and other substances were determined. NO_3^- in the juice disappeared after 3 months' storage at 37°C and Sn was dissolved to a concn. of about 100 ppm after 6 months storage at 37°C . Canning of juice containing 5 ppm NO_3^- in plain cans resulted in Sn concn. of >200 ppm after 6 months' storage at 37°C . In coated cans, Sn was not dissolved; however,

ascorbic acid content of the juice decreased considerably and browning and off-flavours were observed. CRI

32

Effect of pH, salt and nitrite in heat-processed meat on destruction and out-growth of P.A. 3679.

Nordin, H. R.; Burke, T.; Webb, G.; Rubin, L. J.; Binnendyke, D. van *Canadian Institute of Food Science and Technology Journal* 8 (2) 58-66 (1975) [14 ref. En, fr] [Canada Packers Ltd., Res. Cent., Toronto, Ontario, Canada]

The effect of temp. on the thermal destruction rate of *Clostridium botulinum* (P.A. 3679) in cured pork medium was assessed. Ground pork containing (i) salt, (ii) NaNO_2 and (iii) sodium tripolyphosphate at levels of 2.8%, 200 ppm and 0.5% respectively, was inoculated with spores of P.A. 3679, stuffed into tubes, sealed and heated in steam at $100\text{--}121.1^\circ\text{C}$ for various times. The number of surviving spores was determined using a MPN technique. D-values were determined at 5 temp. for a number of spore crops. Logarithms of these values were plotted against temp. to obtain Z values of $8.6\text{--}10.5^\circ\text{C}$. Omission of (i), (ii), (iii) or all 3 from the pork medium did not affect appreciably the D value at 115.5°C . Ground pork at various pH levels of (i) or (ii) concn. was inoculated at a level of 10^5 spores of P.A. 3679/g and heated in tubes at 115.5°C for 30 min. These were examined periodically for outgrowth, and the time at which this occurred was recorded. The % of the tubes which showed no visible signs of outgrowth after 150 days was plotted against pH with (i) at 2.6%, (ii) at 150 ppm; against (i) concn. with pH at 5.8 and 6.4, and (ii) at 150 ppm; and against (ii) concn. with pH at 5.8 and 6.4, and (i) at 2.6%. Outgrowth increased with pH and decreased with concn. of (i) and (ii). The effect of (ii) in the range 0-400 ppm was similar to that of (i) in the range 0-4%. The effect of pH in the range 5-7 was greater than that of concn. of (i) or (ii). AS

33

Contribution of nitrite and nitrate to the colour and flavour of cured meats. [Lecture]

MacDougall, D. B.; Mottram, D. S.; Rhodes, D. N. *Journal of the Science of Food and Agriculture* 26 (11) 1743-1754 (1975) [48 ref. En] [Meat Res. Inst., Langford, Bristol BS18 7DY, UK]

The formation of nitric oxide myoglobin from nitrite and myoglobin involves a complex series of reactions not all of which are completely understood even now, and the stability of the cured colour, so important from the marketing point of view, continues to be investigated. The amount of nitrite necessary for complete formation of nitric oxide myoglobin is very small and the presence of no more than 25 mg/kg of nitrite in the cured meat is enough to ensure an adequately stable colour. At least 4 times this level is essential to produce a full development of the typical cured flavour. Very

little is known of the mechanism of the reactions leading to the formation of cured flavours in cooked products or of the identity of the volatile substances responsible for it. AS

34

Growth of *Staphylococcus* and *Salmonella* on frankfurters with and without sodium nitrite.

Bayne, H. G.; Michener, H. D.

Applied Microbiology 30 (5) 844-849 (1975) [27 ref. En] [W. Regional Res. Lab., USDA, Berkeley, California 94710, USA]

Conventional and nitrite-free frankfurters in loosely wrapped packages were compared as to their ability to support growth of *Salmonella*, *Staphylococcus*, and their naturally occurring spoilage flora at 7°C (simulating refrigerated storage) and 20°C (simulating possible temp. abuse). At 7°C, *Salmonella* did not grow in either type of frankfurter; *Staphylococcus* and the natural spoilage flora sometimes grew more rapidly in the absence of nitrite, but the difference was not significant. At 20°C, growth of *Salmonella*, *Staphylococcus*, and of the spoilage flora was, at most, only slightly faster on nitrite-free frankfurters. *Salmonella* was not suppressed in culture experiments at the pH and nitrite content found in frankfurters. Although either type of frankfurter can become hazardous due to growth of *Salmonella* or *Staphylococcus*, no unusual or additional hazard resulted from the omission of nitrite from frankfurters. AS

35

The microbiological role of nitrite and nitrate.

[Lecture]

Roberts, T. A.

Journal of the Science of Food and Agriculture 26 (11) 1755-1760 (1975) [41 ref. En] [Meat Res. Inst., Langford, Bristol BS18 7DY, UK]

In unheated products nitrite, together with NaCl and the pH value, contributes to selection of bacteria which grow during storage. Nitrate per se is generally believed to serve only as a reservoir for nitrite, but commercial use of nitrate-free cover brines in the Wiltshire bacon industry shows that such a reservoir is not always essential. Nitrate sometimes reduced the growth rate of bacteria in experimental Wiltshire collar bacon, but was of no benefit in back bacon. The clostridia occurring naturally in the bacon grew to higher numbers in collar cured without nitrate than that cured with nitrate. *Clostridium botulinum* (types A and B) was detected in these bacons, but did not grow in the bacon. In heated products the growth of surviving bacteria is controlled by interaction of several factors including pH, NaCl, storage temp. and sodium nitrite or a substance derived from it upon heating. Further experiments are warranted to investigate the effects of dextrose, nitrate, ascorbate and polyphosphate. AS

36

[Testing of water. Determination of nitrates.]

France, Association Francaise de Normalisation (AFNOR)

French Standard NF T90-012, 2pp. (1975) [Fr]

37

[Testing of water. Determination of nitrites.]

France, Association Francaise de Normalisation (AFNOR)

French Standard NF T90-013, 2pp. (1975) [Fr]

39

[Meat and meat products. Determination of nitrites (reference method).]

France, Association Francaise de Normalisation (AFNOR)

French Standard NF V04-409, 4pp. (1974) [Fr]

A reference method for detn. of nitrites in meat and meat products is described, based on hot-water extraction of nitrite from the homogenized sample, deproteinization of the extract by boiling with potassium hexacyanoferrate + zinc acetate + disodium borate, addition of colour reagent (sulphanilamide chloride + naphthylethylenediamine) to the filtered deproteinized extract, and detn. of the extinction value of the resulting red solution at 538 nm. AJDW

40

[Meat and meat products. Determination of nitrates (reference method).]

France, Association Francaise de Normalisation (AFNOR)

French Standard NF V04-410, 7pp. (1974) [Fr]

A reference method for detn. of nitrates in meat and meat products is described, based on hot-water extraction of nitrates + nitrites from the homogenized sample, and deproteinization of the extract by boiling with potassium hexacyanoferrate + zinc acetate + disodium borate. An aliquot of the filtered deproteinized extract is analysed for nitrites [see preceding abstr.]; in a further aliquot, nitrates are reduced to nitrites by means of a Cd column, and the total nitrite concn. (i.e. nitrite originally present, and nitrite formed from nitrate) is determined by the method specified in the preceding abstr. Nitrate concn. in the sample may then be calculated. AJDW

41

The association of bacteria and nitrites in carrot juice.

Hicks, J. R.; Stall, R. E.; Hall, C. B.

Journal of the American Society for Horticultural Science 100 (4) 402-403 (1975) [8 ref. En]
[Univ. of Florida, Gainesville, Florida, USA]

The nitrite level in carrot juice at 20°C increased rapidly for ≤16 h when bacterial levels were >10⁶ cells/ml. (max concn. 13.89 ppm nitrite). After 16 h, nitrite concn. declined, though there was no decrease in bacterial population. No increase in nitrite occurred when bacterial growth was prevented by holding at 5°C or by addition of potassium dehydroacetate, but nitrite was produced at 5°C when the bacterial level was raised to 10⁸ cells/ml. Representatives of isolated but unidentified colony types from the juice were all shown to be facultative anaerobes. JRR

42

Quality and nitrate-nitrite levels of canned spinach during storage.

Sistrunk, W. A.; Cash, J. N.

Arkansas Farm Research 23 (4) 11 (1975) [En]

Storage changes in the quality of canned spinach were investigated for the savoyed-leaf and smooth leaf types; the former is usually considered to be more acceptable but contains higher nitrates. Seven lots of canned spinach (2 smooth-leaf and 2 savoyed-leaf canned commercially and 2 savoy and 1 semi-savoy canned experimentally) were stored for 2 yr and examined at intervals for tenderness (shear press), colour and texture (organoleptic) and contents of nitrate and nitrite. Differences in quality and nitrate-nitrite levels were found between lots, but these appeared to be related to maturity of the raw product, with no difference between the spinach types. General trends were towards decreasing greenness and increased darkness, loss of leaf texture character, and increasing toughness during the first 6 months, with little further change between 6 months and 2 yr. Nitrates and nitrites both increased for 6 months; thereafter nitrates decreased and nitrites remained constant. Numerical data are tabulated. ELC

43

[Effects of nitrite on cured meat products during storage.]

Erlandsson, G.-B.; Nilsson, G.; Fuchs, G.

Var Föda 26 (3) 46-55 (1974) [16 ref. Sv, en]

27 raw, cooked and/or smoked cured meat products of various types (differing in meat content, moisture content, cooking and smoking conditions and amounts of ascorbic acid (0 or 200 mg/kg) and nitrite (60-159 mg/kg) added during curing) were used in a study on factors influencing changes during storage at 8°C up to the last recommended date for consumption. Tables of values are given for the Eh value, residual nitrite concn., pH and count of aerobic bacteria in the stored meat samples. The results are discussed in detail.

Products with a low meat content, cured with low nitrite concn. and not strongly heat treated showed high bacterial counts and low residual nitrite concn. (approx. 3% of the amount added). Smoked hot dogs and boiled products also had low residual nitrite concn. (6-9% of the amount added) but underwent little bacterial growth. In the other products, residual nitrite concn. was ≤21-23% of the amount added, and little change in bacterial count, pH or Eh was observed during storage. AJDW

44

[Spectrophotometric determination of nitrites and nitrates in curing salts.]

Lara, W. H.; Takahashi, M. Y.

Revista do Instituto Adolfo Lutz 34, 35-39 (1974)
[12 ref. Pt, en] [Inst. Adolfo Lutz, Sao Paulo, Brazil]

The method described is based on the findings of Wetters & Uglum [Analytical Chemistry (1970) 42, 335] that the ratio between absorption of NaNO₂ at 355 nm and that at 302 nm is constant at 2.5; and that NaNO₃ shows no absorption at 355 nm although it has a characteristic absorption band at 302 nm. Cl ions exert no interference on these relationships. 30 mixtures with different proportions of NaCl (9.55-99.4%), NaNO₂ (0.1-2.5%) and NaNO₃ (0.1-3.0%) were prepared. Results of spectrophotometric detn. of NaNO₂ and NaNO₃ in these mixtures using standard curves were in close agreement with those of customary detn. using α-naphthylamine and phenoldisulphonic acid, respectively (correlation coeff., 0.99 and 0.98, respectively). SKK

45

[The effect of temperature on the rate of decomposition of nitrites and nitrates and on the process of myoglobin conversion into nitrosomyoglobin in cured pork.]

Nevescanin, S.

Tehnologija Mesa 16 (1) 9-12 (1975) [10 ref. Sh, en] [IMK "29. novembar", Subotica, Yugoslavia]

The decomposition of NaNO₂ and NaNO₃ (injected as brine) in ham was studied after holding the hams for 48 h at 6-8°C, after pasteurization at 80°C for 60 min, and after sterilization at 110°C for 40 min. Concn. of NaNO₂ and NaNO₃ were determined, together with the % of myoglobin converted into nitrosomyoglobin. Tables of results are given. Nitrite decomposition in sterilized samples was approx. double that in pasteurized samples; nitrites were decomposed much more easily than nitrates. Nitrosomyoglobin formation increased with increasing processing temp. STI

46

Reaction of sodium nitrite with dimethylglycine produces nitrososarcosine.

Friedman, M. A.

Bulletin of Environmental Contamination and Toxicology 13 (2) 226-232 (1975) [19 ref. En]

[Dep. of Pharmacology, Med. Coll. of Virginia, Health Sci. Div., Virginia Commonwealth Univ., Richmond, Virginia 23298, USA]

47

[Biological effect of nitrates in drinking water.]

Ivanov, A. V.; Petukhov, N. I.; Shamsutdinov, N. Sh.

Gigiena i Sanitariya No. 12, 9-11 (1975) [3 ref. Ru, en] [Kazanskii Med. Inst., USSR]

On the basis of animal tests, it is recommended that the max. permissible concn. of nitrates in drinking water be set at 40 mg/l. HBr

48

Variations in nitrate accumulation among spinach cultivars.

Barker, A. V.; Maynard, D. N.; Mills, H. A.

Journal of the American Society for Horticultural Science 99 (2) 132-134 (1974) [12 ref. En]

[Dep. of Plant & Soil Sci., Univ. of Massachusetts, Amherst, Massachusetts, USA]

18 spinach cultivars were found to vary considerably in NO_3 concn. in their leaves, (0.08-0.18%). Smooth-leaved cultivars were lower in NO_3 concn. than heavily savoyed cultivars (0.08-0.11% vs 0.13-0.18% nitrate N, dry wt. basis). Some medium or semisavoyed cultivars were low NO_3 accumulators, and others were high accumulators. A low degree of savoyedness appears to be a useful factor in the selection of spinach cultivars with tendencies for low NO_3 accumulation. AS

49

Nitrate accumulation in spinach as influenced by leaf type.

Maynard, D. N.; Barker, A. V.

Journal of the American Society for Horticultural Science 99 (2) 135-138 (1974) [22 ref. En]

[Dep. of Plant & Soil Sci., Univ. of Massachusetts, Amherst, Massachusetts, USA]

Spinach, *Spinacia oleracea* L., cultivars America, Heavy Pack, and Hybrid 424 were grown in sand culture with variable NO_3 concn. from 0.187 to 48 m-equiv./l. The cultivars were representative of savoyed, semisavoyed, and smooth-leaf types, respectively. The plants were harvested when those cultured at 12 and 18 m-equiv. NO_3 /l. had obtained approx. market maturity. At this time an

array of deficiency, sufficiency, and toxicity symptoms were evident. Great differences in NO_3 accumulation and critical NO_3 concn. occurred among cultivars. Critical NO_3 -N concn. for the whole leaves of spinach plants were: 'America', 0.17%, 'Heavy Pack', 0.15%, and 'Hybrid 424', 0.045% of their dry wt. Calculations relating spinach consumption and impaired human health suggest that adult health should not be affected even with massive ingestion of spinach. AS

50

Effects of nitrogen source, rate, and inhibition of nitrification on the growth and nitrate accumulation in some vegetables.

Mills, H. A.

Dissertation Abstracts International, B 36 (2) 504-505: Order No. 75-16582 (1975) [En]

[Massachusetts Univ., Amherst, Massachusetts, USA]

The influence of a nitrification-suppressor, 2-chloro-6-(trichloromethyl)pyridine (Nitrapyrin, Dow Chemical Co.), on accumulation of nitrate in radishes and spinach was investigated at levels of 5, 10 and 50 ppm in the soil. All levels of Nitrapyrin suppressed nitrate accumulation following $(\text{NH}_4)_2\text{SO}_4$ and/or KNO_3 fertilization even up to 100-800 mg N/kg soil. Unlike other vegetables, growth of radish and spinach was not restricted by Nitrapyrin; however, the yield of spinach became sensitive to Nitrapyrin as the proportion of N supplied by NH_4 -fertilization increased. AMW

51

Effect of nitrite and erythorbate on growth of *Bacillus cereus* in cooked sausage and in laboratory media.

Raevuori, M.

Zentralblatt für Bakteriologie, Parasitenkunde, Infektionskrankheiten und Hygiene, IB 161 (3)

280-287 (1975) [26 ref. En, de] [Dep. of Food Hygiene, Coll. of Vet. Med., Helsinki, Finland]

B. cereus spores were inoculated (at a calculated level of 5000/g) into sausage mass before cooking. The sausages were kept at 20°C for 48 h before bacteriological and physicochemical analyses were done. Addition of 200 mg/kg sodium nitrite and 500 mg/kg sodium erythorbate before cooking totally prevented growth of 2 strains of *B. cereus* tested. Increasing the amount of erythorbate did not affect the antibacterial properties of the nitrite. The inhibitory effects of different combinations of the additives were also studied in laboratory media. Public health aspects of the use of nitrite and erythorbate as food additives are discussed. AS

52

Effect of muscle type on residual nitrite in cured meat.

Lee, S. H.; Cassens, R. G.; Fennema, O. R.
Journal of Food Science 41 (1) 100-101 (1976) [9 ref. En] [Muscle Biol. Lab., Univ. of Wisconsin, Madison, Wisconsin 53706, USA]

When a cured meat model system was made from white muscle it contained less residual nitrite than if it were made from a red muscle; this effect is due to the lower pH of white muscle. If the pH of red and white muscle is similar then the slightly lower residual nitrite in products made from red muscle probably is due to the greater content of myoglobin in red muscle. IFT

53

The effects of benzoic acid and nitrite on toxin production by *Clostridium botulinum* type E.

Gudding, R.; Nordal, J.
Acta Agriculturae Scandinavica 26 (1) 47-51 (1976) [16 ref. En] [Dep. of Food Hygiene, Vet. Coll. of Norway, Oslo, Norway]

Sodium benzoate, at a concn. of 5000 ppm, had an inhibitory effect on germination, growth and toxin production by *Cl. botulinum* type E in Robertson's meat broth at pH 5.7. However, 200 ppm nitrite inhibited toxin production more effectively, and may thus be regarded as a better additive for the prevention of type E botulinal toxin production in foods. AS

54

In vivo formation of nitroso compounds. III. Nitrite concentration in human saliva collected from salivary ducts.

Ishiwata, H.; Tanimura, A.; Ishidate, M.
Journal of the Food Hygienic Society of Japan [Shokuhin Eiseigaku Zasshi] 16 (2) 89-92 (1975) [7 ref. En] [Nat. Inst. of Hygienic Sci., Kamiyoga 1-chome, Setagaya-ku, Tokyo, Japan]

See FSTA (1976) 8 1J70 for part II.

55

In vivo formation of nitroso compounds. IV. Changes of nitrite and nitrate concentration in incubated human saliva.

Ishiwata, H.; Boriboon, P.; Harada, M.; Tanimura, A.; Ishidate, M.
Journal of the Food Hygienic Society of Japan [Shokuhin Eiseigaku Zasshi] 16 (2) 93-98 (1975) [9 ref. En] [Nat. Inst. of Hygienic Sci., Kamiyoga 1-chome, Setagaya-ku, Tokyo, Japan]

See preceding abstr. for part III.

56

[Nitrate and nitrite contents of prepared meals in relation to the nitrate content of drinking water.]

Nitrat- und Nitritgehalt von fertigen Speisen in Beziehung zum Nitratgehalt des Trinkwassers.
 Selenka, F.; Brand, E.
Zentralblatt für Bakteriologie, Parasitenkunde, Infektionskrankheiten und Hygiene, IB 161 (3) 266-279 (1975) [32 ref. De, en] [Hygiene-Inst., Johannes Gutenberg-Univ., Mainz, Federal Republic of Germany]

In view of the carcinogenic properties of nitrosamines and the possibility of nitrosamine formation in the digestive tract from ingested nitrate and secondary amines, in the presence of reducing bacteria, the effect of the nitrate content of drinking water on the amounts of nitrate and nitrite in prepared foods, and the quantities consumed at each meal, were studied. Restaurant meals which had been served without previously informing the owner, and samples of the water supply from the same establishments, were analysed for nitrate and nitrite in the various components. Nitrate contents of the drinking water in the four regions studied averaged <1, 19.5, 35.6 and 130 mg/l., while the amounts of nitrate ingested per meal were 46, 67, 45 and 67 mg, respectively; corresponding figures for nitrite intake were 1.4, 2.0, 1.5 and 2.8 mg/meal. Thus nitrate consumption in the principal meal in an area with 130 mg $\text{NO}_3^-/\text{l.}$ in the water supply was only $1.4 \times$ that in an area with a water supply practically free of nitrate; the corresponding nitrite intake however was double that in the nitrate-free area. Average nitrate concn. (NO_3^-/kg) in potatoes (94 mg), salads (109 mg) and vegetables (99 mg) were double those of soup and meat portions (50 and 58 mg, respectively). [Continued in following abstr.] BDH

57

[Nitrate and nitrite contents of prepared meals in relation to the nitrate content of drinking water.]

Nitrat- und Nitritgehalt von fertigen Speisen in Beziehung zum Nitratgehalt des Trinkwassers.
 Selenka, F.; Brand, E.
Zentralblatt für Bakteriologie, Parasitenkunde, Infektionskrankheiten und Hygiene, IB 161 (3) 266-279 (1975) [32 ref. De, en] [Hygiene-Inst., Johannes Gutenberg-Univ., Mainz, Federal Republic of Germany]

[Continued from preceding abstr.] The nitrate content of the water supply affected only the amounts of nitrate in soups and meat (a 4-fold increase in the area with 130 mg $\text{NO}_3^-/\text{l.}$ in the water relative to the nitrate-free supply). In contrast, the nitrite levels (NO_2^-/kg) were highest in soups and meals (4.7 mg and 3.5 mg), decreasing to 2.5 mg in potatoes, 1.8 mg in vegetables and 1.4 mg in salads. The values obtained are considered representative of those for the population as a whole. BDH

58

Nitrate accumulation in radish as affected by nitrapyrin.

Mills, H. A.; Barker, A. V.; Mynard, D. N. *Agronomy Journal* 68 (1) 13-17 (1976) [24 ref. En] [Univ. of Georgia, Athens, Georgia, USA]

Ingestion of $\text{NO}_3\text{-N}$ in vegetables represents a major source of dietary intake of $\text{NO}_3\text{-N}$ and is potentially hazardous to human health. Radish (*Raphanus sativus* L.), when cultured in a NO_3 rich medium accumulates substantial quantities of $\text{NO}_3\text{-N}$. The main objective of this study was to evaluate the influence of a nitrification suppressor, 2-chloro-6-(trichloromethyl) pyridine (nitrapyrin), on $\text{NO}_3\text{-N}$ accumulation in radish plants. Nitrate accumulation in the plants was less with $(\text{NH}_4)_2\text{SO}_4$ fertilization than with KNO_3 fertilization, and all nitrapyrin applications (0, 5, 10, or 50 mg/pot) essentially eliminated the accumulation in both roots and shoots. Total N concn. of shoots were significantly greater with $\text{NH}_4\text{-N}$ than with $\text{NO}_3\text{-N}$ nutrition although total N in roots was unaffected by N treatment. AS

59

[Nitrite and nitrate contents of fish products.]

Tauts, O. V.; Kann, Yu. M. [Kann, J.]; Kask, K. A. *Tallina Politehnilise Instituudi Toimetised* No. 367, 95-100 (1974) [5 ref. Ru, de]

Mean values with ranges are tabulated for (i) nitrite and (ii) nitrate contents (determined by the method described earlier [see FSTA (1975) 7 3S392]) of 1-5 samples of 14 spp. of fresh sea fish, 9 spp. of hot-smoked fish, and 3 spp. of fried fish. It is concluded that (i) and (ii) contents did not exceed the accepted limits; that cooking and frying reduced (i) and (ii) contents; that hot-smoking increased (i) content 5 × and (ii) contents 1.3 ×; and that addition of ascorbic acid markedly reduced (i) content. SKK

60

Sensitization of heat-damaged spores of *Clostridium botulinum*, type B to sodium chloride and sodium nitrite.

Jarvis, B.; Rhodes, A. C.; King, S. E.; Patel, M. *Journal of Food Technology* 11 (1) 41-50 (1976) [16 ref. En] [Microbiol. Dep., Leatherhead Food RA, Randalls Road, Leatherhead, Surrey, UK]

Spores of *Clostridium botulinum* type B (NCTC7273) were sensitized to the inhibitory action of 2.5% and 3.5% w/w NaCl by heating at 85°, 90° or 95°C at pH 6.0 and pH 6.5. Spores heated at 70° or 80°C were not significantly sensitized to these concn. of NaCl but they were sensitized to 4.5% and 5.5% NaCl. A significant salt-nitrite interaction was observed only at NaCl levels of 4.5% and above. Heat-shocked spores and spores heated through a 'I-D process' at 70° or 95°C were more sensitive to nitrite heated in meat or in culture medium (121°/10 min) than to unheated nitrite added after heating. However, no differences in sensitivity to the heated nitrite (Perigo factor) were observed with spores heated at 70° and 95°C. AS

61

The history and use of nitrate and nitrite in the curing of meat. [Lecture]

Binkerd, E. F.; Kolari, O. E.

Food and Cosmetics Toxicology 13 (6) 655-661 (1975) [25 ref. En] [Armour & Co., Food Res. Div., Oak Brook, Illinois 60521, USA]

This review describes the early curing of meat, curing practices from colonial to modern times, outlines the basic studies elucidating the use of nitrite, discusses studies leading to current regulations governing the use of nitrate and nitrite and describes current practice in the industry. The following tables are included: nitrate and nitrite contents of cured meats in 1936 and 1937; nitrite and nitrate contents of cured meat products analysed by USDA, MIP and AMI laboratories Chicago, Illinois, in 1970; calculated input, range and average nitrite contents of selected shelf-stable and pasteurized meat products in 1972; nitrite concn. in selected cured meat products in 1972; and comparison of the range of input of nitrate and nitrite in 1970-1974. VJG

62

Meat and meat products - determination of nitrite content (Reference method).

International Organization for Standardization *International Standard ISO 2918-1974*, 3pp. (1975) [En]

The nitrite content of meat and products determined according to the procedure described in this standard is expressed as mg of sodium nitrite/kg (ppm). The standard covers scope and field of application, definition, principle, reagents, apparatus, sample, procedure, expression of results and test report. The principle of the method involves extraction of a test portion (about 10 g, weighed to the nearest 0.001 g) with hot water, precipitation of the proteins, filtration, development of a red colour in the presence of nitrite by the addition of sulphanilamide and N-1-naphthylethylenediamine dihydrochloride to the filtrate, and photometric measurement at a wavelength of 538 nm. AL

63

Meat and meat products - determination of nitrate content (Reference method).

International Organization for Standardization *International Standard ISO 3091-1974*, 5pp. (1975) [En]

This standard specifies a reference method for detn. of nitrate content of meat and meat products, expressed as mg of potassium nitrate/kg (ppm). It covers reagents, apparatus, sample, procedure, expression of results and test report. The principle of the method involves extraction of a test portion (at least 200 g) with hot water, precipitation of the proteins and filtration, reduction of the extracted nitrates to nitrite by metallic Cd, development of a red colour by addition of sulphanilamide and N-1-naphthylethylenediamine dihydrochloride to the filtrate, and photometric measurement at a wavelength of 538 nm. The apparatus for nitrate reduction is illustrated. AL

64

Rapid nitrosation of phenols and its implications for health hazards from dietary nitrites.

Challis, B. C.

Nature, UK 244 (5416) 466 (1973) [12 ref. En] [Dep. of Organic Chem., Imperial Coll., London SW7 2AY, UK]

The interaction of dietary nitrite with phenolic compounds, either in food processing or in the digestive tract, is discussed. There is little information on the possible carcinogenicity of nitrosophenols, but if they prove to be harmless then phenolic compounds in the diet and gastric juice may effectively remove nitrite salts before they interact with secondary amines or other nitrogenous material to form carcinogenic N-nitrosamines. AL

65

Nitrate-induced corrosion of tin plate as affected by organic acid food components.

Albu-Yaron, A.; Semel, A.

Journal of Agricultural and Food Chemistry 24 (2) 344-348 (1976) [25 ref. En] [Div. of Food Tech., Volcani Cent., Bet Dagan, Israel]

The accelerating effect of nitrates on dissolution of tin in tin-plated cans of acid products was investigated in model experiments. The relative contribution to tin dissolution of 3 typical organic acid food solutions (at a total of 1% acid concn.), citric acid, malic acid, and their mixture with oxalic acid, found naturally as a complexing system in fruits and juices having a pH of 3.5, was explored. The behaviour of 3 levels of nitrate, 50, 125 and 250 ppm, was compared in pure acid solutions and in acid solutions with 15% added sucrose. The effectiveness of addition of 500 ppm of ascorbic acid in inhibiting this type of corrosion was tested. The decrease in nitrate concn. and the increase in concn. of tin and iron were followed in canned model solutions throughout suitable storage periods at room temp. The order of corrosion rates in pure acid solutions was: mixture of acids > citric acid ≥ malic acid. Addition of sucrose and sucrose-ascorbic acid to acid solutions reduced the rate of tin dissolution in the mixture of acids and in malic acid, but had no effect in citric acid solutions. AS

66

Chromatographic separation and analysis of environmental pollutants.

Sievers, R. E.; Tesch, J. W.; Rehg, W. R.; Ross, W. D.

Abstracts of Papers, American Chemical Society 171 (Centennial), ANAL 75 (1976) [En] [Dep. of Chem., Univ. of Colorado, Boulder, Colorado 80309, USA]

Gas chromatography with electron capture detection can be used for analysis of nitrate and nitrite in aqueous environmental and biomedical samples. A simple chemical pretreatment is required in which the sample is converted to a volatile aromatic compound such as nitrobenzene,

which is suitable for gas chromatographic analysis. Nitrites are determined by difference by treating a second identical sample with H_2O_2 . The excellent sensitivity of the electron capture detector for nitroaromatic compounds (e.g. detection limit approx. 1 pg for nitrobenzene) enables sub-ppm determinations to be made on a single drop of sample. The method has been applied to analysis of saliva, drinking water, urine, and other samples. AS

67

[Estimation of nitrate and its content in beer and in raw materials used in brewing.] Nitratbestimmung und Nitratgehalt in Bier und Brauereirohstoffen.

[Lecture]

Postel, W.

Brauwissenschaft 29 (2) 39-44 (1976) [17 ref. De, en, fr, es] [Lehrstuhl für Allgemeine Lebensmitteltech., Tech. Univ. München, 8050 Freising-Weihenstephan, Federal Republic of Germany]

A method for estimation of nitrate is described, based on clarification of the sample with potassium hexacyanoferrate + zinc sulphate; reduction of nitrate to nitrite by means of a Cd sponge; and photometric detn. of nitrite by diazotization of sulphanilic acid and coupling with α -naphthylamine. 192 samples of bottled beers had an average nitrate concn. of 34 mg/l. (range 1.4-101.3 mg/l.); 35 samples of brewing water had nitrate contents of not detectable-53 mg/l. Hops contained 480-1190 mg nitrate/100 g (average 861 mg/100 g); conc. hop powders contained 870-1070 mg nitrate/100 g, and hop extracts contained 70-2430 mg nitrate/100 g, depending on the total resin content. Malt contained 0.1-4.4 mg nitrate/100 g. TUB-IGB

68

Quality constituents of carrots *Daucus carota* L. as influenced by nitrogen and potassium fertilization.

[Lecture]

Habben, J.

Acta Horticulturae No. 29, 295-305 (1973) [22 ref. En, ru] [Res. Inst. of Vegetable Crops, Tech. Univ., Munich, Federal Republic of Germany]

Pot trials were carried out to determine the effects of different levels of N and K on the content of carotene, sugar, nitrate, and crude fibre of carrots (*Daucus carota* L.) at different stages of development. Increasing N levels in the range from 0.3-2.4 g/pot resulted in an increase of carotene. There were little differences in the carotene values for carrots receiving different amounts of K (0.6-4.8 g K_2O /pot). Carotene content increased during the growing period and was more affected by stage of maturity than by fertilization. Total sugars (TS) remained practically constant throughout the growing period, although there was a change in form, as is shown by an increase in reducing sugars (RD) and a decrease in non-reducing sugars (NRD) as the season advanced. The percentage of RD decreased with the addition of K while that of NRD increased at a lower rate, so that the TS decreased slightly. N had little effect on TS but enhanced RD and lowered NRD. Nitrate accumulation was increased by N fertilization. Carrots grown during

winter in a greenhouse were higher in nitrate content than those matured during the summer, due to different light intensities. However, even in the season with low light intensity nitrate accumulation remained so little that there seems to be no risk of a detrimental nutritional effect. There was little effect of fertilizer level on crude fibre content. [See FSTA (1976) 8 8J1218] AS

69

Yield, nitrate levels and sensory properties of spinach as influenced by organic and mineral nitrogen fertiliser levels.

Maga, J. A.; Moore, F. D.; Oshima, N.

Journal of the Science of Food and Agriculture 27 (2) 109-114 (1976) [21 ref. En] [Colorado State Univ., Fort Collins, Colorado 80523, USA]

Spinach was fertilized at 2 levels of N, 140 kg/ha (x) and 420 kg/ha (3x), using split applications of ammonium sulphate and dried blood as N sources. Single application of ammonium sulphate 19 days prior to harvest was also tested. A no-N control was also employed. The x rate of mineral N produced statistically the same yield as the 3x organic source but at a lower tissue nitrate level. The 3x mineral fertilizer produced highest yield and nitrate concn. Excluding late fertilizer application, nitrate levels were closely related to yield and dependent upon rate of N availability from each of the 2 sources. Late application of mineral N did not increase yield over a no-N application control, but resulted in an 8-fold increase in tissue nitrate. Triangle taste panels demonstrated significant differences in raw, cooked, and frozen samples when comparing the no-N application against both the 3x organic and mineral N applications and late mineral application. No significant sensory differences resulted between organic and mineral fertilizers at either application level. Colour measurements revealed that higher N application darkened colour. Organic sources gave darker colours than corresponding mineral fertilizer levels. Late application of mineral N resulted in the darkest colour. GLC headspace scans demonstrated that increasing N rates from x to 3x approx. doubled total peak area. No qualitative differences were noted. Late application of mineral fertilizer resulted in a headspace scan similar those obtained at the 3x N rates. AS

70

[Composition and properties of milk from cows fed greenstuff from pasture fertilized with high levels of mineral nitrogen.]

Leonhard-Kluz, I.; Wierny, A.; Bielak, F.; Pasička, E.; Wierna, W.; Zwyczok, H.

Roczniki Naukowe Zootechniki 1 (1) 117-124 (1974) [9 ref. Pl, en, ru] [Samodzielna Pracownia Mleczarstwa Inst. Zootech., Aleksandrowice, Poland]

27 Polish Black-and-White Lowland cows in 3 groups were red during the summer with green fodder cut from pasture fertilized with 100, 300 or 500 kg N/ha. With increasing level of N fertilization there was a significant increase in nitrate and nitrite content of milk, an increase in its

urea content, an increase in its renneting time and a reduction in its titratable acidity. There were no significant effects on milk yield, protein and fat contents, TS, density or animal health. ADL

71

[Investigations on some constituents and properties of the milk of cows fed on hay from grassland fertilized with high levels of mineral nitrogen.]

Leonhard-Kluz, I.; Wierny, A.; Bielak, F.; Pasička, E.; Zwyczok, H.

Roczniki Naukowe Zootechniki 1 (1) 111-115 (1974) [7 ref. Pl, en, ru] [Samodzielna Pracownia Mleczarstwa Inst. Zootech., Aleksandrowice, Poland]

30 Polish Red-and-White Lowland heifers in 3 groups were fed during a 56-day experimental period (in winter) with hay from pastures fertilized with 100, 300 or 500 kg N/ha. It was found that the increase in nitrate and nitrite content of the fodder was associated with a corresponding increase in the content of nitrates (from 0.127 to 0.199 mg%) and nitrites (from 0.022-0.034 mg%) in milk, as well as an increase in renneting time (from 240 to 440 s). There were no significant effects on milk yield, protein content, fat content, TS, titratable acidity, or animal health. ADL

72

Effects of varying levels of nitrate and nitrite on *Staphylococcus aureus* growth in pepperoni.

Jedlicka, G. J.; Wilcox, J. C.; McCall, W. A.; Gacula, M. C., Jr.

Abstracts of the Annual Meeting of the American Society for Microbiology 75, 200 (1975) [En] [Food Res. Div., Armour Food Co., Oak Brook, Illinois, USA]

The effects of 16 combinations of sodium nitrate and sodium nitrite on pepperoni inoculated with *Staph. aureus* were studied. Microbiological and chemical profiles during production and subsequent storage under 3 different conditions were analysed using Response Surface Methodology (RSM). Results indicate that nitrate alone is ineffective in controlling *Staphylococcus* growth but enhances the bactericidal effect of nitrite. Using the RSM plots to select appropriate product characteristics, such as lactobacilli levels, final moisture levels, residual cure levels, and greatest *Staphylococcus* control, indicates the optimum cure level to be added is 100 ppm sodium nitrate and 75 ppm sodium nitrite. AS

73

The determination of nitrate and nitrite in food.

Fawcett, R.; Tame, D. A.; Johnson, T. E.

Journal of the Association of Public Analysts 14 (1) 23-25 (1976) [3 ref. En] [Kent County Council Lab., County Hall, Maidstone, Kent, UK]

The method presented, based on a rapid cd reduction procedure [FSTA (1971) 3 12S1486], overcomes the difficulty of obtaining a solution sufficiently clear for spectrophotometric estimation of colour. Estimation of nitrite is made by coupling

with naphthyl ethylene diamine and colorimetric determination at 538 nm; the colour may be extracted with n-butanol and determined at 545 nm if the aqueous solution is turbid. Nitrate is reduced to nitrite with spongy cd, as described previously, and determined as above. Results of analyses on baby foods (46 samples devoid of nitrite, 22 containing nitrate), vegetables (12 samples devoid of nitrite, 10 containing nitrate) and meats (16 pork sausage samples and 3 beef sausage samples with no nitrite, cooked sausages containing 5-75 ppm nitrite, 10 meat paste samples with no nitrite, 23 corned beef samples with 0-5 ppm nitrite, 5 prepacked bacon samples with 5-50 ppm nitrite, 21 canned meat samples with 0-220 ppm nitrite) are given in an appendix. JRR

74

Dose-response study of the carcinogenicity of dietary sodium nitrite and morpholine in rats and hamsters.

Shank, R. C.; Newberne, P. M.

Food and Cosmetics Toxicology 14 (1) 1-8 (1976) [22 ref. En] [Dep. of Nutr. & Food Sci., Massachusetts Inst. of Tech., Cambridge, Massachusetts 02139, USA]

Long-term feeding studies were conducted in Sprague-Dawley rats and Syrian golden hamsters using various dietary concn. of nitrite and morpholine (≤ 1000 ppm of each) or N-nitrosomorpholine (5 or 50 ppm). Morpholine, a cyclic amine that was used until recently as an anticorrosive agent in boiler water, represents an unintentional additive in foods such as canned ham. Most combinations of the chemicals induced a high incidence of hepato-cellular carcinoma in rats and a lower incidence in hamsters. The 1000 ppm level had a stronger potential for carcinogenesis in rats and hamsters than did the 50 ppm level of N-nitrosomorpholine. The nitrite concn. in the diet seemed to have a greater effect on incidence of tumours in the rat than did concn. of morpholine. A dose-response relationship was therefore demonstrated for the induction of liver and ling tumours by dietary sodium nitrite and morpholine, these tumours being identical to those induced by the preformed nitrosamine, N-nitrosomorpholine. VJC

75

[Studies on acute toxicities. II. Comparison of acute toxicities of sodium and potassium nitrite and sodium and potassium nitrate.]

Ichikawa, H.; Kobayashi, H.; Yano, N.; Kamiya, N.; Yoshida, S.; Hiraga, K.

Annual Report of Tokyo Metropolitan Research Laboratory of Public Health 25, 535-539 (1974, publ. 1975) [4 ref. Ja, en] [Tokyo Metropolitan Res. Lab. of Public Health, 24-1, Hyakunincho 3 chome, Shinjuku-ku, Tokyo 160, Japan]

Acute oral toxicities of nitrites and nitrates were examined and compared in mice and rats. LD₅₀ values of nitrites differed, the sodium salt being more toxic than the potassium salt. LD₅₀ values of nitrates also differed, the potassium salt being more

toxic than the sodium salt. Results indicated that the lethal action of nitrites depends on the nitrite ion, and that of nitrates depends on sodium or potassium ions. [From En summ.] JA

76

[Methaemoglobin formation and the toxicity of sodium nitrite, potassium nitrite, sodium nitrate and potassium nitrate.]

Ikawa, M.; Ichikawa, H.; Kobayashi, H.; Yoshida, S.; Nakao, T.; Hiraga, K.

Annual Report of Tokyo Metropolitan Research Laboratory of Public Health 25, 541-545 (1974, publ. 1975) [5 ref. Ja] [Tokyo Metropolitan Res. Lab. of Public Health, 24-1, Hyakunincho 3 chome, Shinjuku-ku, Tokyo 160, Japan]

77

[Effect of cooking on nitrates, vitamin C, magnesium and iron content of spinach.]

Astler-Dumas, M.

Annales de la Nutrition et de l'Alimentation 29 (3) 239-244 (1975) [4 ref. Fr, en] [Lab. du Cent. de Recherches Foch, 4 Avenue de l'Observatoire, 75006 Paris, France]

Changes in (i) NO₃, (ii) ascorbic acid, (iii) Mg and (iv) Fe contents during blanching and cooking were studied in frozen and fresh spinach. After blanching 150 g samples were cooked for 5 or 10 min in 0.5 or 1 l. of water, or cooked for 10 min in butter or 15 min in oil. Tabulated results showed that smallest losses occurred during cooking in oil. (ii) was reduced to 78 and 72% in oil and butter respectively, vs. 27-12% (frozen), 45-25% (fresh product) after boiling. Similar results were obtained for (i) while (iii) was lost more slowly and (iv) was resistant to cooking loss e.g. after 5 min boiling in 0.5 l. water, (i) and (ii) were retained at about 30%, (iii) at 70% and (iv) at 100%. Corresponding values after 10 min boiling in 1 l. (i) 17%, (ii) 25%, (iii) 60% and (iv) 78% (all figures for fresh spinach). RM

78

[Contents of nitrite and nitrate in Korean Kimchi and in human saliva.]

Kwon, H. H.

Korean Journal of Nutrition 7 (4) 193-195 (1974) [8 ref. Ko, en] [Nat. Inst. of Health, Seoul, S. Korea]

Nitrite and nitrate contents were analysed and found to be respectively 0.25-0.68 ppm and 35-92 ppm in 10 Kimchi samples collected from markets in Seoul, and 1.9-5.0 ppm and 7.6-28.0 ppm in human saliva. KoSFoST

79

Effect of nitrite and ascorbate on formation of botulinal toxin in cured meats.

Bowen, V. G.; Deibel, R. H.

Abstracts of the Annual Meeting of the American Society for Microbiology 74, 13 (1974) [En] [Univ. of Wisconsin, Madison, Wisconsin, USA]

Nitrite prevents formation of *Clostridium botulinum* toxin in cured meat products. The effect of added ascorbate on the efficacy of nitrite inhibition of toxin formation was examined in wieners and bacon that were inoculated with *Cl. botulinum* spores and temp. abused. Toxicity tests in mice revealed that toxin production was inhibited by nitrite at levels $>50 \mu\text{g/g}$ of wiener. Ascorbate at levels of 0, 105, and $655 \mu\text{g/g}$ did not decrease the effectiveness of the nitrite inhibition nor did ascorbate potentiate it. Mouse toxicity tests of bacon emulsions indicated that levels of ascorbate $>500 \mu\text{g/g}$ were associated with a greater incidence of toxic samples, thus indicating a definitive impairment of the nitrite inhibition of *Cl. botulinum* toxin production. AS

80

[Effects of pH, temperature and salt on the nitrate reductase activity of *Micrococcus* strain M_{III}.] Der Einfluss von pH-Wert, Temperatur und Salzgehalt auf die Nitratreduktaseaktivität des Mikrokokkenstammes M_{III}. [Lecture] Puolanne, E.

Proceedings of the European Meeting of Meat Research Workers 19 (Part III) 1059-1069 (1973) [2 ref. De] [Inst. für Fleischtech., Univ., Helsinki, Finland]

Effects of pH (4.6-7.5), NaCl concn. in the medium (0.5-12%) and temp. (2-55°C) on the nitrate reductase activity of *Micrococcus* strain M_{III} (a strain of importance in sausage starter cultures) were studied. Tables of results are given. Effects of pH were relatively small, especially over the range pH 5.2-7.0. Max. nitrate reductase activity was observed at approx. 50°C; activity at temp. $<10^\circ\text{C}$ was very low. Nitrate reductase activity decreased slightly with increasing NaCl concn., especially at NaCl concn. $>6.0\%$. [See FSTA (1976) 8 9S1589.] AJDW

81

The influence of nitrite on cured pork flavor. [Lecture]

Ockerman, H. W.; Hadden, J. P.; Cahill, V. R. *Proceedings of the European Meeting of Meat Research Workers* 19 (Part IV) 1493-1499 (1973) [9 ref. En, fr, de, ru] [Ohio State Univ., Columbus, Ohio 43210, USA]

Effects of salt concn. (0 or 2%) and NaNO_2 concn. (0, 20, 156 or 200 ppm) on the organoleptic properties of cured pork were studied. Samples were evaluated organoleptically before storage, and after storage at ≤ 5 wk at 3°C or for ≤ 14 wk at -29°C . Stored samples were also evaluated by GLC headspace analysis and detn. of the TBA value. Tables of results are given. Taste panellists preferred the flavour of products made with nitrite; nitrite significantly influenced headspace vapour composition, and increased storage stability of the product. [See FSTA (1976) 8 9S1589.] AJDW

82

The effect of sodium nitrite on the organoleptic properties of processed meat products. [Lecture] Skjelkvaale, R.; Valland, M.; Russwurm, H., Jr. *Proceedings of the European Meeting of Meat Research Workers* 19 (Part IV) 1501-1515 (1973) [6 ref. En, de, fr, ru] [Nat. Inst. of Tech., Oslo, Norway]

Studies on the effect of added nitrite concn. (0, 40 or 80 ppm) on the flavour, composition (fat, moisture, protein) and microbiological quality of (i) smoked boiling sausages, (ii) frankfurters and (iii) meat loaf are described. Effects of incorporation of 0.3 g ascorbic acid/kg in (ii) were also studied. Organoleptic properties of (i) were evaluated after storage for 3 days, those of (ii) after 3 and 11 days, and those of (iii) after 3, 11 and 17 days. Tables of results are given. In general, taste panellists could distinguish between products made with and without nitrite, but could not distinguish between products made with different levels of nitrite. No significant preference for any sample was observed. Effects of ascorbic acid on the flavour of (ii) were unclear. All products were of good bacteriological quality; nitrite concn. had no significant effect on composition. [See FSTA (1976) 8 9S1589.] AJDW

83

Recent studies on the role of sodium nitrite and sodium nitrate in cured meat products. [Lecture] Herring, H. K.

Proceedings of the European Meeting of Meat Research Workers 19 (Part IV) 1517-1540 (1973) [7 ref. En, de, fr, ru] [Armour & Co., 801 W. 22nd Street, Oak Brook, Illinois 60521, USA]

Studies on the use of NaNO_2 and NaNO_3 in wieners and in a canned chopped ham product and the use of NaNO_2 in bacon are briefly discussed. Aspects considered include flavour, nitrosamine formation, control of growth and toxin production by *Clostridium botulinum*, decreases in nitrite concn. during processing and storage, and the nitrite concn. required for satisfactory quality and safety of these products. [See FSTA (1976) 8 9S1589.] AJDW

84

[Inhibition of Enterobacteriaceae, including salmonellae, in meat products by nitrite.] [Lecture] Leistner, L.; Hechelmann, H.; Uchida, K.

Proceedings of the European Meeting of Meat Research Workers 19 (Part IV) 1541-1552 (1973) [10 ref. De, en, ru] [Inst. für Bakteriologie und Histologie, Bundesanstalt für Fleischforschung, Kulmbach, Federal Republic of Germany]

Samples of Brühwurst (scalded sausage) containing 2% NaCl and 0, 50, 75 or 100 ppm NaNO_2 were inoculated with cultures of salmonellae, enteropathogenic *Escherichia coli*, or organisms of the *Klebsiella*/*Enterobacter*/*Hafnia* group. They were then vacuum-packaged and stored at 8°C for ≤ 3 wk; at intervals, they were tested bacteriologically. Salmonellae and *E. coli*

were inhibited by nitrite, the inhibition being more marked for salmonellae than for *E. coli*. No inhibition of bacteria of the *Klebsiella/Enterobacter/Hafnia* group was observed. In a second study, samples of raw fermented sausage made with 2.6% NaCl and 0, 65, 98 or 130 ppm NaNO_2 were inoculated with salmonellae; counts of salmonellae were determined at intervals during ripening for ≤ 16 days. Addition of NaNO_2 inhibited multiplication of salmonellae. [See *FSTA* (1976) 8 9S1589.] AJDW

85

[Meat and meat products. Determination of nitrite content.]

Romania, Institutul Roman de Standardizare
Rumanian Standard STAS 9065/9-74 5pp. (1974)
[Ro]

This standard (partially superseding *STAS 961-66*, published in 1966) prescribes 2 methods for detn. of nitrites in meat and meat products: the method of Griess (obligatory in cases of litigation) based on reaction of nitrite (in a deproteinized extract of the product under examination) with sulphanilic acid + α -naphthylamine, and detn. of the extinction value (at 520 nm) of the resulting pink complex; and the Lombard-Zambelli method, based on reaction of the nitrite with sulphanilic acid + phenol to form a yellow-orange complex which may be determined by spectrophotometry at 430 nm, or by comparison with a graded series of standards. [See also preceding abstr.] AJDW

86

Nitrite, nitrosamines, and cancer.

Issenberg, P.

Federation Proceedings 35 (6) 1322-1326 (1976)
[37 ref. En] [Eppley Inst. for Res. in Cancer,
Univ. of Nebraska Med. Cent., Omaha, Nebraska
68105, USA]

The danger of occurrence of carcinogenic N-nitroso compounds and their precursors in foods is discussed, with reference to: the carcinogenicity of these compounds; factors influencing their formation in foods or in the digestive tract; methods for detection and detn. of these compounds; and examples of the occurrence of N-nitroso compounds in foods. AJDW

87

Inhibitory capacity of sodium benzoate for nitrate-induced corrosion of tin plate.

Albu-Yaron, A.; Semel, A.

Journal of Food Science 41 (3) 703-705 (1976)
[19 ref. En] [Div. of Food Tech., Packaging Res.
Lab., Inst. for Tech. & Storage of Agric. Products,
ARO, Volcani Cent., Bet Dagan, Israel]

The efficiency of adding 3 levels of sodium benzoate (100, 1000, 2500 ppm) in inhibiting corrosion of tin by different organic acid solutions (pH 3.5) containing 125 ppm nitrate was tested in canned model packs experiments. Model pH 3.5

solutions, consisting of 1% citric acid, or 1% malic acid, or a mixture of 0.8% citric acid + 0.1% malic + 0.1% oxalic acid, and containing 15% sucrose, 500 ppm ascorbic acid and 125 ppm NO_3 , were compared with and without the addition of sodium benzoate. The decrease in the nitrate concn. and the increase in the concn. of tin and iron were followed in the canned model solutions throughout suitable storage periods at room temp. The amounts of dissolved tin and iron were taken as corrosion criteria. Inhibitory efficiency was expressed as the ratio of corrosion rates in solutions with and without the addition of an inhibitor. Results showed that sodium benzoate gave incomplete protection against corrosion of tin by nitrate. Addition of sodium benzoate, e.g. at 1000 ppm, showed that it is most inhibitive in citric acid, less so in malic acid, and least in the 1% citric-malic-oxalic acid mixture. IFT

88

Rapid screening determination of nitrate in baby food using the nitrate-selective electrode.

Liedtke, M. A.; Meloan, C. E.

Journal of Agricultural and Food Chemistry 24 (2) 410-412 (1976) [4 ref. En] [Dep. of Chem.,
Kansas State Univ., Manhattan, Kansas 66506,
USA]

A nitrate-selective electrode was used to rapidly determine the nitrate N content of baby foods. Interferences were eliminated by the use of 2 cation resins (Al and Ag). Of 53 samples analysed, 5 (green beans, garden vegetables, spinach, squash, and beets) contained >20 ppm nitrate N. The method is fast (15-20 min) but appears to read a few ppm high for samples having a nitrate N content less than about 10 ppm. AS

89

Collaborative study of the colorimetric determination of nitrate and nitrite in cheese.

Hamilton, J. E.

Journal of the Association of Official Analytical Chemists 59 (2) 284-288 (1976) [7 ref. En]
[FDA, 599 Delaware Street, Buffalo, New York
14202, USA]

A quantitative colorimetric method for the detn. of nitrate and nitrite in cheese has been subjected to collaborative study. The method includes clarification of an aqueous extract of cheese with zinc hydroxide, reduction of nitrate to nitrite via a spongy cadmium column (the nitrite originally present is unaltered), diazotization of sulphanilic acid with the nitrite, and coupling with 1-naphthylamine hydrochloride to form a pink azo dye whose absorbance is measured at 522 nm. The spectrophotometric responses are compared to a standard curve. In samples containing both nitrate and nitrite, nitrate is determined by difference. A SD of 5.5 was obtained (5 of 6 collaborators) when a cheese sample spiked with 276 ppm NaNO_3 was analysed by the method. The method has been adopted as official first action. AS

90

A survey of fish products for volatile N-nitrosamines.

Iyengar, J. R.; Panalaks, T.; Miles, W. F.; Sen, N. P.

Journal of the Science of Food and Agriculture 27 (6) 527-530 (1976) [35 ref. En] [Food Res. Lab., Food Directorate, Health Protection Branch, Health & Welfare Canada, Ottawa, Ontario, K1A 0L2, Canada]

A study was undertaken to determine the levels of nitrate, nitrite and volatile N-nitrosamines in various fish products (halibut, salmon, cod, sole, ocean perch, scallops). The samples were analysed for 5 volatile nitrosamines, namely dimethylnitrosamine (DMN), diethylnitrosamine (DEN), dibutylnitrosamine (DBN), nitrosopyrrolidine (NPyr) and nitrosopiperidine (NPip), all of which are potent carcinogens. Both GLC (Coulson electrolytic conductivity detector, pyrolytic mode) and TLC methods were used for estimating the levels of nitrosamines. The average level of nitrate was 8 part/10⁶ (range 0-94 parts/10⁶), and nitrite was present in traces only. Traces of DMN (3-12 parts/10⁹) were found in some uncooked (raw) fish. Increased levels of DMN (3-18 parts/10⁹) and traces of DEN (4-14 parts/10⁹) were observed after baking and frying, indicating formation of these compounds during cooking. None of the samples contained DBN, NPyr or NPip. In 10 of 15 samples the identities and levels of DMN and DEN were confirmed by GLC-high resolution MS. AS

91

[Direct determination of nitrate ions in meat products.]

Selmeçi, G.; Aczel, A.; Peter, S.

Élelmiszervizsgálati Közlemények 21 (4) 187-194 (1975) [8 ref. Hu, ru, de, en, fr] [Megyei Élelmiszerell. Vegyvizg. Int., Szeged, Hungary]

The photometric method of Müller & Widemann [no ref. given], based on nitration of sodium salicylate, was found to be suitable for detn. of nitrate ions in extracts of meat products, protein and pigments being removed from the extract before analysis. A semi-micro version of this technique permitted detn. of nitrate at a concn. of 5 ppm, with an error of $\pm 7.4\%$. For in-plant control, a variant based on visual evaluation is described; error id $\pm 25-30\%$. IF

92

The fate of nitrite: reaction with protein.

Woolford, G.; Cassens, R. G.; Greaser, M. L.; Sebranek, J. G.

Journal of Food Science 41 (3) 585-588 (1976) [24 ref. En] [Muscle Biol. Lab., Univ. of Wisconsin, Madison, Wisconsin 53706, USA]

This paper presents results showing that one of the major pathways for loss of nitrite in cured meats may be through reaction with nonhaem protein. Incorporation of the stable isotope ¹⁵N

from nitrite is shown to occur in both bovine serum albumin and the muscle protein myosin, at pH below and at those found in cured meat. In bovine serum albumin solution at pH 5.5 and at 20°C, 60% loss of added nitrite (200 ppm) occurred within 1 wk and almost half of the lost nitrite N was recovered as ¹⁵N chemically bound to the protein. Analysis of the reaction products of nitrite and myosin showed that, under the conditions used, 10-20% of the incorporated N was present as 3-nitrotyrosine. Several other products were found in acid hydrolysates of protein containing bound nitrite, but these did not appear to quantitatively account for the remainder of the incorporated nitrite. IFT

93

Effect of sodium nitrite and sodium chloride on the flavor of processed pork bellies.

Kimoto, W. I.; Wasserman, A. E.; Talley, F. B.

Lebensmittel-Wissenschaft + Technologie 9 (2) 99-101 (1976) [15 ref. En] [USDA, E. Regional Res. Cent., 600 East Mermaid Lane, Philadelphia, Pennsylvania 19118, USA]

Fresh pork bellies (rind removed) were pumped to 110% of green wt. with curing pickles containing: NaCl + NaNO₂; NaCl; or NaNO₂. Pumped and unpumped (control) bellies were stored in polyethylene bags at 34°F for 18-24 h then cut in half. One half of each belly was processed with smoke and the other without smoke until the temp. reached 127°F. Processed bellies were stored at 34°F for 12-18 h, then placed in a freezer for 1.5-2 h to harden tissues, sliced about 2 mm thick, fried for 5 min and submitted to sensory evaluation. Results were subjected to statistical analyses. Most of the difference among treatments was due to the effect of NaCl. Bacon cured with NaCl alone was rated as having only slightly less flavour than the control, while in the absence of NaCl much flavour was noted. Presence of NaNO₂ in the curing pickle also had a significant effect on flavour; in the presence of NaCl, the expected enhanced flavour due to NaNO₂ was obtained. However, NaNO₂ alone could not evoke the same level of response as the control. Panelists readily identified samples processed without NaCl and gave them low flavour scores. The effect of smoke was not significant. JA

94

Formation of nitrosylmyoglobin in bacon involving lactate dehydrogenase.

Cheah, K. S.

Journal of Food Technology 11 (2) 181-186 (1976) [8 ref. En] [ARC Meat Res. Inst., Langford, Bristol BS18 7DY, UK]

When cured bacon was exposed to the air the metmyoglobin (MetMb) induced was reconverted to nitrosylmyoglobin (NOMb) by repacking the bacon in vacuo and storing the packs for 1-2 wk at 5°C. The experimental evidence suggested that NOMb formation involved MetMb reduction by NADH formed from NAD⁺ and lactate by lactate

dehydrogenase (EC 1.1.1.27). All the components of this system were found to be present in bacon. The observation was supported by experiments showing in vitro NOMB formation using lactate dehydrogenase, NAD^+ , MetMb and nitrite at pH values normally found in bacon. AS

95

The occurrence and growth of *Clostridium* spp. in vacuum-packed bacon with particular reference to *Cl. perfringens* (welchii) and *Cl. botulinum*.

Roberts, T. A.; Smart, J. L.

Journal of Food Technology 11 (3) 229-244 (1976) [23 ref. En] [Agric. Res. Council, Meat Res. Inst., Langford, Bristol BS18 7DY, UK]

Presumptive *Clostridium* spp. were detected in 234 of 263 25 g samples of vacuum-packed bacon, 64 of which contained *Cl. perfringens* and 11 *Cl. botulinum* (10 confirmed as type B and 1 type A). Growth of presumptive *Clostridium* spp. occurred in vacuum packs stored at 15°, 20° and 25°C but growth of *Cl. perfringens* or *Cl. botulinum* never occurred. Growth of clostridia was not related to any particular curing process, though some of the results suggested that the role of nitrate in their control should be further investigated. In a subsequent batch of unsliced collar bacon, of 26 175 g samples, 19 contained *Cl. botulinum* type A. AS

96

Rapporteurs' papers presented at the 20th European meeting of meat research workers, Dublin, September 15-20, 1974. [Conference proceedings]

Ireland, Republic of, An Foras Taluntais
Proceedings of the European Meeting of Meat Research Workers No. 20, 224pp. (1975) [many ref. En, De, Fr] Dublin, Irish Republic

The text is given of rapporteurs' papers presented at this symposium. The first section 'The stress syndrome and meat quality' consists of the following papers: Genetics, growth and development, by M. J. Clancy (pp. 1-16, 9 ref., En); Physiology, by D. Lister (pp. 17-27, 13 ref., En); Muscle biochemistry, by J. V. McLoughlin (pp. 28-32, En); and Handling, transport and slaughter, by W. Sybesma (pp. 33-37, 4 ref., En). The second section 'Nitrites and nitrosamines in processed meats' consists of the following papers: Medical aspects, by R. G. Cassens (pp. 38-48, 7 ref., En); Chemistry, by M. Ranken (pp. 49-63, 10 ref., En); Microbiology, by L. Leistner (pp. 64-91, De); and General papers on meat processing, by F. P. Niinivarra (pp. 92-107, De). The third section 'Packaging fresh and cured meat' consists of the following papers: Metabolism of meat in the package, by D. E. Hood (pp. 108-121, 13 ref., En); Quality of fresh and packaged meat, by G. Heinz (pp. 122-138, De); Changes during storage, by G. A. Gardner (pp. 139-146, 17 ref., En); and General papers on packaging, by A. A. Taylor (pp. 147-152, En). The fourth section 'Refrigeration, freezing and

thawing' includes the following papers: Engineering problems - the cold chain, by T. Nilsson (pp. 153-161, En); [continued in following abstr.] AJDW

97

[Reductive dechlorination of DDT during cooking of meat, and nitrite-inhibition of this process.]

[Lecture]

Shumkova, I. A.; Karpova, I. N.; Ruzankova, L. D.; Alekseeva, L. I.

Proceedings of the European Meeting of Meat Research Workers No. 20, 80-82 (1975) [20 ref. Ru, en, de, fr] [Vses. Nauchno-issled. Inst. Myasnoi Promyshlennosti, USSR]

Studies on reductive dechlorination of DDT in meat during cooking are described; tables of results are given for DDT and DDD concn. in raw and cooked meat of various fat contents, in the presence or absence of nitrite. The results show that considerable reductive dechlorination of DDT to DDD takes place during cooking; dechlorination increases with increasing fat content of the meat. Addition of 7.5 mg% nitrite before cooking almost totally inhibited dechlorination. [From En summ.] [See FSTA (1976) 8 10S1831.] AJDW

98

[Binding of sodium nitrite to the myofibrillar fraction of porcine muscle.] [Lecture]

Goutefongea, R.; Renerre, M.; Valin, C.

Proceedings of the European Meeting of Meat Research Workers No. 20, 88-90 (1975) [19 ref. Fr, en, de] [Sta. de Recherches sur la Viande, INRA, Theix, 63110 Beaumont, France]

Factors influencing binding of NaNO_2 to porcine myofibrils (extracted from the longissimus dorsi muscle 24 h post-mortem) were studied. Myofibrils were incubated for 20 h at 4°C with 180 µg NaNO_2 /g muscle, with or without 30 µg NaCl /g muscle. Effects of pH (5.5, 6.0 or 6.5) and heat treatment (none, or at 55°, 68° or 116/117°C) on NaNO_2 binding were studied. A table of results is given. In general, approx. 10% of the added NaNO_2 was bound to the myofibrils; NaCl , pH and heat treatment had very little effect on binding of NaNO_2 to the myofibrils. [See FSTA (1976) 8 10S1831.] AJDW

99

Bacterial stability of vacuum packed Wiltshire bacon cured with and without nitrate. [Lecture]

Shaw, B. G.

Proceedings of the European Meeting of Meat Research Workers No. 20, 114-116 (1975) [8 ref. En, fr, de, ru] [ARC Meat Res. Inst., Langford, Bristol, UK]

Wiltshire-cure back and collar bacon was manufactured using brines containing 0 or 5000 ppm NaNO_3 , and 250, 500, 1000 or 2000 ppm NaNO_2 . Slices were vacuum packaged, and stored for ≤36 days at 5° or 15°C; total counts and counts of lactic acid bacteria and Gram-negative bacteria were determined at intervals. No nitrate was

required for bacterial stability of back bacon cured in brine containing ≥ 1000 ppm nitrite; back bacon cured in nitrate free brines containing ≤ 500 ppm nitrite underwent souring caused by lactic acid bacteria. Nitrate improved the stability of collar bacon, at all nitrite concn. studied; this may be attributable to high counts of Gram-negative bacteria in nitrate-free bacon. [See FSTA (1976) 8 10S1831.] AJDW

100

The colour stability of vacuum packed Wiltshire bacon cured with diminishing quantities of nitrite. [Lecture]

MacDougall, D. B.

Proceedings of the European Meeting of Meat Research Workers No. 20, 153-155 (1975) [10 ref. En, fr, de, ru] [ARC Meat Res. Inst., Langford, Bristol, UK]

Bacon sides, cured by a nitrate-free Wiltshire process incorporating hand pumping and immersion in brines containing 2000, 1000, 500 and 250 ppm nitrite, were sliced and stored in vacuum packs both in the light and in the dark at 5°C and 15°C for 5 wk. Bacon cured at the 2000, 1000 and 500 ppm levels had no colour defects; in that cured at the 250 ppm level there were uncured areas which remained after cooking. During storage the lean became more opaque and increased in lightness, and metmyoglobin in some areas was converted to nitrosylmyoglobin. [See FSTA (1976) 8 10S1831.] AS

101

[Toxicological potentiation studies of food additives. II. Subchronic oral toxicity of butylated hydroxy toluene (BHT), sodium nitrite and their combination in rats.]

Ichikawa, H.; Fujii, T.; Kobayashi, H.; Sakamoto, Y.; Hayashida, S.; Yoneyama, M.; Ikeda, T.; Yano, N.; Konno, T.; Hiraga, K.

Annual Report of Tokyo Metropolitan Research Laboratory of Public Health 23, 345-371 (1971, publ. 1972) [15 ref. Ja, en] [Dep. of Toxicology, Tokyo Metropolitan Res. Lab. of Public Health, Tokyo, Japan]

Rats were fed for 25 wk with diets containing 0.0125, 0.05, 0.2 or 0.8% BHT, or 0.0025, 0.01, 0.04 or 0.16% sodium nitrite, or 0.2% BHT + 0.0025, 0.01, 0.04 or 0.16% sodium nitrite. Weight gain was inhibited in groups receiving the test compounds. There was an increase in liver wt. with increasing dosage of BHT. Effects of the test compounds on haematological and clinical-chemical values were slight. Histological changes in kidney and liver were found in groups receiving BHT. [See FSTA (1975) 5 2T100 for part I.] AS

102

Survey of food products for volatile N-nitrosamines.

Havery, D. C.; Kline, D. A.; Miletta, E. M.; Joe, F. L., Jr.; Fazio, T.

Journal of the Association of Official Analytical Chemists 59 (3) 540-546 (1976) [36 ref. En]

[Div. of Chem. & Physics, FDA, Washington, DC 20204, USA]

A variety of food products (bacon, ham, pork products, baby foods, cheeses, fats, oils, total diets, spice-cure mixtures and Icelandic foods) containing nitrite were analysed for 14 volatile N-nitrosamines by a method demonstrated to be sensitive to 10 parts/billion. 121 food samples were screened for volatile N-nitrosamine content. N-nitrosopyrrolidine was confirmed in fried bacon at levels ≤ 139 parts/billion. N-dimethylnitrosamine, N-nitrosopyrrolidine, and N-nitrosopiperidine were also confirmed in spice-cure mixtures at levels ranging from 50 to 2000 parts/billion. AS

103

- **[An easy method for determining the nitrite content of nitrite curing salt.]** Eine einfache Methode zur Überprüfung des Nitritgehaltes von Nitritpökelsalz.

Hofmann, K.

Fleischwirtschaft 56 (4) 486 (1976) [De] [Bundesanstalt für Fleischforschung, 8650 Kulmbach, Federal Republic of Germany]

The concn. of NO_2^- in nitrite curing salt is determined by dipping Merckoquant nitrite test rods (E. Merck, Darmstadt) into a solution of 4 g curing salt in 1.5 l. water. Based on the colour reaction of NO_2^- with Griess's reagent, concn. of 1, 5, 10, 25 and 50 ppm NO_2^- (or 1.5, 7.5, 15, 37.5 and 75 ppm NaNO_2) can be directly read from a colour scale. The accuracy of the test is about $\pm 10\%$ and was not affected by 4000 ppm Na^+ and 6400 ppm Cl^- . Under correct storage conditions (closed containers at cool temp.) test rods kept their original sensitivity for 2 yr. RM

104

[Reduction of the nitrite content of meat products during storage.]

Erlandsson, G. B.; Fuchs, G.; Nilsson, G.

Var Föda 26 (8) 218-222 (1974) [7 ref. Sv, en] [Dep. of Microbiol., Agric. Coll., S-75007 Uppsala, Sweden]

Samples of sausage meat containing 2.5% NaCl, 200 mg ascorbic acid/kg and 0, 100, 150 or 200 mg nitrite/kg were canned, pasteurized, and stored at 5°, 10° or 15°C for ≤ 20 days. At intervals, samples were analysed for residual nitrite. Graphs of results are given. Nitrite concn. decreased sharply shortly after mixing with the sausage meat, then increased slightly during pasteurization. Nitrite concn. then decreased slowly, the rate and extent of the decrease increasing with increasing storage temp. Residual nitrite levels were low (only 2-40% of the initial level). AJDW

105

[The effect of various thermal processing techniques on the properties of meat emulsion.]

Stamenkovic, T.; Crnic, S.; Sokolic, Z.; Satovic, V. *Tehnologija Mesa* 16 (4) 98-100 (1975) [12 ref. Sh] [Jugoslavenski Inst. za Tehnologiju Mesa,

Belgrade, Yugoslavia]

Effects of heat treatment at 80°C for 240 min or at 115°C for 65 min on various characteristics (wt. loss, juice release, organoleptic properties, chemical and physico-chemical properties) of meat emulsions in cans or in impermeable or steam-permeable casings were studied. Tables of results are given. Nitrite decomposition and meat colour were found to be influenced by pack type and heat treatment conditions. STI

106

[Effect of vacuum processing the sausage material on properties of heat processed sausages.] Tisljarec, D.; Sokolic, Z.; Cavlek, B.; Matic, S. *Tehnologija Mesa* 16 (10) 274-277 (1975) [8 ref. Sh, en] [PIK "Vrbovec", Vrbovec, Yugoslavia]

The effects of processing the emulsion under vacuum on the quality of heat processed beef/pork fat sausages were studied. The ingredients were minced in a cutter for 5 min either under vacuum (80 kN/m²), or not under vacuum. The emulsion was then filled (under vacuum or not) into gas-impermeable artificial casings, diam. 60 mm. The sausages were then heat treated for 105 min at 75°C, and cooled to 20°C. Colour intensity and nitrite and nitrosomyoglobin concn. were determined. Tables and graphs of results are given. Vacuum processing was found to have considerable effects on the composition of sausages, markedly improving intensity and stability of the pink coloration. STI

107

[Nitrite in meat products.] Nitrit in Fleischwaren. [Lecture]

Krol, I. B.

Wiener Tierärztliche Monatsschrift 63 (5) 161-165 (1976) [39 ref. De, en] [Inst. für Nahrungsmittel Tierischer Herkunft, Reichsuniv., Utrecht, Netherlands]

This review discusses chemical, microbiological and toxicological aspects relating to the addition of nitrite to meat products. Alternatives to nitrite are proposed and the possibility of reducing the amount of nitrite added or of limiting the amount of residual nitrite is considered. JA

108

N-nitrosopyrrolidine collected as a volatile during heat-induced formation in nitrite-containing pork.

Warthesen, J. J.; Bills, D. D.; Scanlan, R. A.;

Libbey, L. M.

Journal of Agricultural and Food Chemistry 24 (4) 892-894 (1976) [12 ref. En] [Dep. of Food Sci. & Tech., Oregon State Univ., Corvallis, Oregon 97331, USA]

Ground pork belly containing 200 ppm of sodium nitrite was heated to 177°C and the condensate was collected and analysed for N-nitrosopyrrolidine using gas chromatography and MS. Nitrosopyrrolidine in an amount equivalent to 19 parts/billion (average) in the initial ground pork sample was detected in the condensate. When the

total amount of nitrosopyrrolidine in the cooked pork, rendered fat, and condensate was determined, it was found that 20-40% of the total nitrosopyrrolidine produced was given off as a volatile during the cooking process. The amount of nitrosopyrrolidine produced was increased when 0.1% putrescine was added to the ground pork prior to heating. The addition of an equal amount of proline resulted in the production of even higher levels of nitrosopyrrolidine. AS

109

Nitrites and bacon curing. [Lecture]

Schaffner, R. M.

Association of Food and Drug Officials, Quarterly Bulletin 40 (2) 129-132 (1976) [En] [Bureau of Foods, FDA, 200 C Street S.W., Washington, DC 20204, USA]

The experimental evidence concerning nitrosamine formation in bacon is briefly reviewed, and the FDA proposals on nitrite regulation are outlined. JRR

110

[Research on possible reduction of nitrite levels in heat processed sausages.]

Raseta, J.; Kepcija, D.; Babic, I.; Popovic, J.; Simovic, D.

Tehnologija Mesa 16 (7/8) 194-198 (1975) [11 ref. Sh, en] [Veterinarski Fak., Belgrade, Yugoslavia]

Studies were conducted to determine the min. NaNO₂ concn. required to achieve a stable pink coloration in smoked sausages containing 70% meat and 30% fat. Batches made with ≤30 g NaNO₂/100 kg were evaluated; residual NaNO₂, moisture and protein concn., pH and colour, taste and flavour were determined immediately after production and after storage for ≤7 days at 5°C. The results show that the required coloration may be achieved with 30-50 mg NaNO₂/kg. Nitrite concn. ≥200 mg/kg adversely affected colour. Addition of reducing agents (e.g. ascorbic acid) may reduce the residual nitrite concn. STI

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FAB 48

NITRATES AND NITRITES IN MEAT PRODUCTS

SELECTED FROM VOLUME 9
FOOD SCIENCE AND TECHNOLOGY ABSTRACTS

under the direction of

Commonwealth Agricultural Bureaux, Farnham Royal, Bucks; Gesellschaft für Information und Dokumentation, Frankfurt am Main; Institute of Food Technologists, Chicago; Centrum voor Landbouwpublikaties en Landbouwdocumentatie (Pudoc), Wageningen.

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H. BROOKES
ASSISTANT EDITOR

1

[Colorimetric method for the determination of nitrites.]

Raganowicz, E.; Niewiadomy, A.

Bromatologia i Chemia Toksykologiczna 9 (2) 213-215 (1976) [5 ref. Pl] [Akad. Rolnicza, 20-033 Lublin, ul. Akademicka 15, Poland]

2

[Nitrate and nitrite in food. Calculation of the average daily intake, and prediction of its range.]

Nitrat und Nitrit in der Ernährung des Menschen. Kalkulation der mittleren Tagesaufnahme und Abschätzung der Schwankungsbreite.

Selenka, F.; Brand-Grimm, D.

Zentralblatt für Bakteriologie, Parasitenkunde, Infektionskrankheiten und Hygiene, IB 162 (5/6) 449-466 (1976) [47 ref. De, en] [Hygiene-Inst., Johannes Gutenberg-Univ., Mainz, Federal Republic of Germany]

Per capita daily intakes of nitrate and nitrite were calculated on the basis of experimental data for the nitrate and nitrite contents of foods, and literature data for average per capita consumption of various foods. Average daily intakes (assuming nitrate- and nitrite-free drinking water) were 49 mg nitrate and 1.7 mg nitrite. Literature data for whole meal samples give average values of 75 mg nitrate and 3.3 mg nitrite. Vegetables are the main source of nitrate in the diet; meat products (and, to a lesser extent, bakery products) are the main sources of nitrite. The significance of other factors (drinking water with a high nitrate or nitrite content; unusually high consumption of certain foods; storage or processing under conditions permitting microbial conversion of nitrate to nitrite) influencing daily nitrate or nitrite intakes is discussed. AJDW

3

[Reduction of nitrate by *Bacillus coagulans* in human saliva.]

Maruyama, S.; Muramatsu, K.; Shimizu, S.; Maki, Y.

Journal of the Food Hygienic Society of Japan [Shokuhin Eiseigaku Zasshi] 17 (1) 19-26 (1976) [19 ref. Ja, en] [Nagano Res. Inst. for Health & Pollution, Amori, Nagano-shi, Japan]

4

[Identification and semiquantitative determination of nitrate ions in water by TLC on UV 254 and FND plates.] Über eine

dünnschichtchromatographische Möglichkeit zur Identifizierung und semiquantitativen Bestimmung von Nitrat-Ionen in Wässern an Fertigfolien UV 254 und FND-Folien.

Thielemann, H.

Zeitschrift für die Gesamte Hygiene und ihre Grenzgebiete 22 (3) 173-174 (1976) [4 ref. De] [Hygiene-Inst., Martin-Luther-Univ., Halle-Wittenberg, German Democratic Republic]

A method for identification and detn. of nitrate in water by TLC on UV 254 or FND (cellulose-

coated) plates, using a butanol/pyridine/25% ammonia (40:20:40) solvent system, is described. Chloride, nitrite, sulphite, phosphate and carbonate ions do not interfere. Nitrate spots on the chromatogram may be identified by means of bromocresol green, congo red, thymol blue, or 1-(2-pyridylazo-2-naphthol). Detection limit is 2-60 µg on UV 254, and 0.2-10 µg on FND plates. IN

5

[Determination of nitrates in water.]

Fradkin, B. I.

Gigiena i Sanitariya No. 6, 94-95 (1976) [3 ref. Ru] [Mednogorskaya Sanepidstantsiya, Mednogorsk, USSR]

A quicker, less laborious variant of the regular method for determining and measuring the presence of a nitrate in water is proposed. Formic acid and zinc dust are added to the sample, which has first been chilled to 7°C. Griess's reagent is added and photometry used to measure the rose-violet colour which indicates a nitrate. The method is sensitive to 0.035 mg nitrate/l. water. KME

6

Effects of nitrapyrin on nitrate accumulation in spinach.

Mills, H. A.; Barker, A. V.; Maynard, D. N.

Journal of the American Society for Horticultural Science 101 (3) 202-204 (1976) [17 ref. En] [Dep. of Plant & Soil Sci., Univ. of Massachusetts, Amherst, Massachusetts 01002, USA]

Consumption of spinach (*Spinacia oleracea* L.) with high NO₃-N contents may be a health hazard to infants. Spinach leaves accumulate NO₃-N when the plants are grown in a soil with high NO₃-N availability. Experiments designed to evaluate the influence of nitrapyrin, a nitrification suppressor (2-chloro-6-(trichloromethyl)pyridine), on NO₃-N concn. in 'America' spinach and to develop a means of fertilization for max. growth and min. NO₃-N levels in spinach were conducted. Nitrate accumulation in whole leaves and leaf fresh wt. were lower with (NH₄)₂SO₄ fertilization than with KNO₃ fertilization. Nitrapyrin caused a further depression of NO₃-N concn. and plant growth with (NH₄)₂SO₄ but had no effect on NO₃-N accumulation and little effect on yield of plants fertilized with KNO₃. The lesser growth with (NH₄)₂SO₄ was apparently due to NH₄-N toxicity. When half of the N was supplied as NH₄-N and half as NO₃-N, growth was equivalent to that of plants receiving only NO₃-N, and NO₃-N accumulation in the leaves was reduced by 35% without nitrapyrin and by >50% with nitrapyrin. With this fertilizer combination, no toxicity to plant growth resulted from nitrapyrin applied at its recommended rate. AS

7

[Can nitrate be omitted in cheese manufacture?]

Kann auf Nitrat bei der Herstellung von Käse verzichtet werden?

Wasserfall, F.

Deutsche Molkerei-Zeitung 97 (23) 677-680

(1976) [19 ref. De] [Bundesanstalt für Milchwirtschaft, Kiel, Federal Republic of Germany]

Late blowing of cheese caused by certain anaerobic sporeformers can be prevented by addition of nitrate to cheese milk. Objections have recently been raised against use of nitrate on the grounds that it could give rise under some conditions to formation of carcinogenic nitrosamines. Literature information on replacement of nitrate by improvement of hygienic quality of cheese milk, bactofugation, use of H_2O_2 , changes in cheesemaking procedure, and use of nisin and lysozyme is considered and discussed. It is concluded that so far, the only suitable measures are improvement of milk quality and use of lysozyme; practical difficulties and cost seem to exclude the latter. It is suggested that hygienic contraindications to the use of nitrate in milk should not be overemphasized. SKK

8

Nitrite binding sites on myoglobin.

Lee, S. H.; Cassens, R. G.

Journal of Food Science 41 (4) 969-970 (1976) [8 ref. En] [Univ. of Wisconsin, Madison, Wisconsin 53706, USA]

^{15}N -labelled nitrite was used to determine the amount of nitric oxide bound to unheated compared to heated myoglobin. Heated samples contained twice the amount of ^{15}N of unheated samples. The globin portion was likely detached from the myoglobin by heating, and 2 sites for binding of nitric oxide were therefore made available. IFT

9

Nitrite in meat products determined by fluorescence quenching of p-aminobenzoate ion.

Coppola, E. D.; Wickroski, A. F.; Hanna, J. G.

Journal of the Association of Official Analytical Chemists 59 (4) 783-786 (1976) [5 ref. En] [Connecticut Agric. Exp. Sta., 123 Huntingdon Street, New Haven, Connecticut 06504, USA]

A direct fluorometric method is presented for determining nitrites in meat products by means of quenching. The extracted sodium nitrite is consumed in a diazotization reaction with a measured excess of the fluorescent reagent p-aminobenzoic acid (PABA) in boiling water and at $pH \leq 1.4$. The amount of decrease in fluorescence (quenching) of PABA; in alkaline medium ($pH 11.0$) with excitation at 265 nm and fluorescence at 339 nm, is directly related to the amount of nitrite present. The slope for the standard curve is 1% decrease in relative fluorescence intensity per 2.76 ppm $NaNO_2$. Results obtained for a series of 20

meat samples analysed by this fluorometric method are in good agreement with results obtained by a colorimetric method with an average difference of ± 6.1 ppm $NaNO_2$. AS

10

Microdetermination of nitrates and nitrites in saliva, blood, water, and suspended particulates in air by gas chromatography.

Tesch, J. W.; Rehg, W. R.; Sievers, R. E.

Journal of Chromatography 126, 743-755 (1976) [13 ref. En] [Dep. of Chem., Univ. of Colorado, Boulder, Colorado 80309, USA]

11

[Microbiologically-justifiable reduction of the quality of nitrite added to meat products.]

Mikrobiologische vertretbare Reduktion des Nitritzusatzes zu Fleischerzeugnissen. (In 'Rückstände in Fleisch und Fleischerzeugnissen' [see FSTA (1977) 9 2S164].) [Lecture] Leistner, L.; Hechelmann, H.; Bem, Z. pp. 186-191 (1975) [12 ref. De, en] [Inst. für Bakteriologie & Histologie, Bundesanstalt für Fleischforschung, 865 Kulmbach-Blaich, Federal Republic of Germany]

The potential for reduction of the quantities of nitrite used in cured meat products is discussed, with special reference to the amounts needed for inhibition of clostridia and other pathogenic bacteria (staphylococci, salmonellae, *Escherichia coli*, shigellae). Studies showed that pathogenic bacteria were controlled by the presence of 110 ppm nitrite in finely-ground fermented sausages, 65 ppm nitrite in sliced Brühwurst sausages, and 400 ppm in covering brines. These values suggest that the nitrite content of nitrite curing salt mixtures could advantageously be reduced by approx. 25% (i.e. from 0.5-0.6% to 0.38-0.45%). The importance of pH and water activity for microbiological stability of products made with reduced nitrite concn. is discussed. AJDW

12

Comparison of the fate of nitrite added to whole meat, meat fractions and model systems.

Emi-Miwa, M.; Okitani, A.; Fujimaki, M.

Agricultural and Biological Chemistry 40 (7) 1387-1392 (1976) [8 ref. En] [Dep. of Agric. Chem., Univ. of Tokyo, Tokyo, Japan]

The fate of nitrite in cured meat was investigated. Of added nitrite-N, 66-90% was found as nitrite, nitrate, nitrosothiol, denatured nitrosomyoglobin and gaseous N compounds; the remaining N was unidentified. The amount of unidentified N depended on both the curing period and the amount of added sodium ascorbate (AS). Pork was separated into 4 fractions: (i) dil. NaCl-soluble small-molecular fraction, (ii) dil. NaCl-soluble large-molecular fraction, (iii) Weber-Edsall

solution-soluble fraction, and (iv) Weber-Edsall solution-insoluble fraction. Each fraction was cured and the fate of nitrite examined. In the absence of AS, almost all nitrite-N was detectable, while in its presence, 73-82% of nitrite-N was detectable in both (i) and (ii), 78-100% in (iii) and 94-100% in (iv). The results suggest that the unidentified nitrite-N in cured meat originates mostly from the reaction between (i), (ii), (iii), nitrite and AS. [See also FSTA (1975) 79S1182.] AS

13

A food scientist looks at fermented sausages.

Palumbo, S. A.

Abstracts of Papers, American Chemical Society 172, AGFD 37 (1976) [En] [E. Regional Res. Cent., USDA, Philadelphia, Pennsylvania 19118, USA]

The ripening period for European dry sausages involves storage at 20°C during which the sausages acquire their characteristic flavour, texture, and colour. During this period, enzymes, generally of microbial origin, attack various substrates in the sausage. The relationship between bacterial flora and their enzyme systems, the substrates and the resulting products is reviewed for several different sausage types. In contrast to European varieties, American sausages have a lower pH and are dried (ripened) at a low temp. (12-15°C). European starter cultures reduce nitrate and usually produce low amounts of acid, while American starter cultures are selected solely for their ability to produce large amounts of acid and usually do not reduce nitrate. Thus, the lactic fermentation products and nitrate reductase activity of American and European sausages should be quite different. The results of studies on factors influencing the lactic fermentation and nitrate reductase activity in Lebanon bologna are presented and, where possible, compared with results for European sausages. AS

14

Methods of test for meat and meat products. VII. Determination of nitrite content.

India, Indian Standards Institution

Indian Standard IS:5960 (Part VII)-1974, 8pp. (1975) [En] Price Rs5.00 [Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi, India]

This standard is based on ISO Draft International Standard 2981, "Meat products, determination of nitrite content (reference method)". The method involves extraction of the test portion with hot water, precipitation of proteins, and filtration. In the presence of nitrite the filtrate develops a red colour on addition of sulphanilamide hydrochloride and N-1-naphthylethylenediamine dihydrochloride. Nitrate is then estimated photometrically at 538 nm. AL

15

Methods of test for meat and meat products. VII. Determination of nitrate content.

India, Indian Standards Institution

Indian Standard IS:5960 (Part VIII)-1974, 11pp. (1975) [En] Price Rs6.00 [Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi, India]

This standard is based on ISO Draft International Standard 3091, "Meat products, determination of nitrate content (reference method)". The method involves extraction of the test portion with hot water, precipitation of proteins and filtration. The extracted nitrates are reduced to nitrites by metallic Cd, and nitrite is estimated as in the preceding abstr. AL

16

[Nitrite, nitrosamines or botulism?]

Snygg, B. G.

SIK Rapport No. 369, 13pp. (1974) [Sv, en] [Svenska Inst. för Konserveringsforskning, Fack, S-4000 21 Göteborg-16, Sweden]

The use of nitrate and nitrite in foods is discussed, with reference to: breakdown products and reaction products of nitrite; the mutagenicity and toxicity of nitrite; functions of nitrate and nitrite in foods (cured colour formation, flavour and aroma development, inhibition of microorganisms); formation of carcinogenic nitrosamines by reaction of nitrite with amines or other N compounds in foods or in the stomach; factors influencing nitrosamine formation (e.g. presence of ascorbic acid); inhibitory effects of nitrite on *Clostridium botulinum*; and the potential for reduction of the nitrate levels in cured products without increasing the risk of growth and toxin formation by *Cl. botulinum*. A table is given of literature data for nitrosamine conc. in foods. AJDW

17

Interactions of atrazine plus nitrite in biological systems.

Marco, G. J.; Boka, G.; Cassidy, J. E.; Ryskiewich, D. P.; Simoneaux, B. J.; Sumner, D. D.

Abstracts of Papers, American Chemical Society 172, PEST 100 (1976) [En] [Agric. Div., CIBA-GEIGY Corp., Swing Road, Greensboro, N. Carolina 27409, USA]

The potential metabolic formation of nitrosoatrazine and nitrosohydroxyatrazine was studied in several biological systems using radiotracer methods. The chemistry of synthetic nitrosoatrazine and nitrosohydroxyatrazine was also studied. The analytical sensitivity for nitrosoatrazine or nitrosohydroxyatrazine was 1-10 parts/billion. Goats fed atrazine produced no detectable nitrosoatrazine in liver, processed muscle, milk and excreta. Fish were exposed to atrazine and NaNO₂ for 21 days. Fish muscle, processed fish muscle and water contained no detectable nitrosoatrazine. Corn was grown to maturity in an acidic soil treated preemergence with 3 lb of atrazine/acre and with a blend of nitrate and nitrite N at time of planting. No detectable nitrosoatrazine was found in corn or soil samples. Similar studies done with hydroxyatrazine in most of the above systems also showed no detectable

nitrosohydroxyatrazine. The stability of nitrosoatrazine was studied in selected biological systems. These studies, simulating atrazine use levels, show no detectable nitrosoatrazine or nitrosohydroxyatrazine indicating that exposure to these compounds is unlikely. AS

18

[Frozen spinach puree - an important diet component.]

Celikovsky, J.; Smotlacha, M.

Prumysl Potravin 27 (6) 314-315 (1976) [Cs]
[Mrázirny, o.p., Prague, Czechoslovakia]

Contents of nitrate in spinach during puree production were (as % of raw spinach value): after washing, 65-73, after blanching, 33-44; and after making puree, 20-38. Contents of nitrate in spinach increased with level of fertilization: at 100 kg N/ha, the content was approx. 1000 mg NO_3^- /kg; and at double this quantity, it was 2000-2500 mg/kg. Nitrite (NO_2^-) content of spinach after gathering was (mg [?/kg]): 24-h storage at 1°C, 0; 24-h storage at 30°C, 50-100. NO_2^- content of defrosted spinach puree held at 20°C as such or after cooking was respectively (mg NO_2^- /kg): after 1 day, 0 and 0; after 3 days, 36 and 780; and after 6 days, 1100 and 1600. SKK

19

Ion selective method for the determination of nitrite in smoked fish.

Sherken, S.

Journal of the Association of Official Analytical Chemists 59 (5) 971-974 (1976) [16 ref. En]
[FDA, 850 Third Avenue, Brooklyn, New York 11232, USA]

In a direct ion selective electrode method for determining nitrite in smoked fish, the nitrite extracted from the sample is converted to nitrous acid with a measured addition of an acid buffer. The released nitrous acid is measured by a nitrogen oxide electrode. A known addition procedure is used to accurately measure the amount of nitrite in solution and the nitrite concn. is determined directly from Gran's plot paper. Recoveries of nitrite from spiked smoked chub samples ranged from 94.0 to 100.0% with an average of 96.7% and a relative SD of $\pm 1.9\%$ at the 100 ppm level. Results from the ion selective method were comparable with those from the official first action AOAC method 24.037-24.038. AS

20

[Possible effects of skim-milk powder and hydrolysed milk protein on lowering the level of nitrite added to heat-sterilized meat products.]

Untersuchungen über die Wirkung von Magermilchpulver und aufgeschlossenem Milcheiweiss im Hinblick auf eine mögliche Senkung des Nitritzusatzes bei hitzesterilisierten Fleischwaren.

Hauser, E.; Hunyady, G.; Schmidhofer, T.; Escher,

F.; Denzler, A.

Fleischwirtschaft 56 (6) 841-845 (1976) [7 ref. De, en, fr] [Inst. für Lebensmittelwissenschaft, Eidgenössische Tech. Hochschule, Universitätsstrasse 6, 8006 Zürich, Switzerland]

The effect of adding 2% dried skim-milk or hydrolysed milk protein on the quality of canned veal and meat loaf was determined. The additions of milk protein could be important for heat stability if NO_3^- or NO_2^- levels in sterilized meat products have to be reduced because of potential nitrosamine formation. Tabulated results showed no difference in organoleptic and bacteriological properties between the products with or without added dried skim-milk or hydrolysed milk protein. Dried milk or milk protein could be detected directly in samples treated at 90°C, but in samples sterilized at 115°C only indirectly from other analytical data (% water, total protein, connective tissue protein). Adequate sterilization was achieved only at 115°C (F values 2.5-3), and was not affected by the presence of milk protein. With the recipes used, the use of dried skim-milk or hydrolysed milk protein brought no advantage. RM

21

[Nitrites and nitrates in Polish meat products.]

Lemieszek-Chodorowska, K.

Roczniki Panstwowego Zakladu Higieny 27 (4) 387-389 (1976) [4 ref. Pl, ru, en] [Panstwowy Zaklad Higieny, Warsaw, Poland]

During 1970-1975, a total of 1952 samples of 5 different groups of Polish meat products (finely and coarsely ground sausages; loin, ham, smoked ham; preserves; 'others') was tested for contents of nitrites and 1694 samples were tested for contents of nitrates. Nitrite (NaNO_2) concn. were generally (72.7%) 50 mg/kg, although 2.6% had contents >150-200 mg/kg; nitrate (KNO_3) concn. were more unevenly distributed; 52.2% had concn. 300 mg/kg, but 10.6% had concn. of >1000-2000 mg/kg, and a further 4% concn. of >2000 mg/kg. It is proposed on the basis of the results that the max. permissible concn. of these substances in meat products be reduced to 50 mg/kg for nitrites and 500 mg/kg for nitrates in canned meats, and to 150 and 1000 mg/kg, respectively, in other meat products. HBr

22

The role of nitrite and nitrate in Lebanon bologna, a fermented sausage.

Zaika, L. L.; Zell, T. E.; Smith, J. L.; Palumbo, S. A.; Kissinger, J. C.

Journal of Food Science 41 (6) 1457-1460 (1976) [12 ref. En] [USDA, E. Regional Res. Cent., Philadelphia, Pennsylvania 19118, USA]

Production of Lebanon bologna by the traditional method using aged salted meat requires nitrate as the curing agent. Elimination of the use of nitrate in meat products is being considered by USA government agencies. The preparation of Lebanon bologna was investigated by 2 processes: either NaNO_2 (0-1600 ppm) or NaNO_3 (0-1850 ppm) was added to aged meat or to fresh meat plus starter culture. Nitric oxide pigment content, pH,

titratable acidity and nitrite concn. were determined during 4 days of fermentation of the bolognas. Sausages prepared with NaNO_2 (78-100 ppm) were comparable to those prepared with NaNO_3 (200-1850 ppm) by either process in pH, titratable acidity and cured meat pigment content. With starter culture and fresh meat, the formation of cured colour and decrease in pH were more rapid than with aged meat. Low levels of NaNO_3 (100 ppm) gave satisfactory colour formation with both processes. In some experiments with bolognas prepared with nitrate, considerable amounts of nitrite were found during the early stages of fermentation. However, after 4 days of fermentation the nitrite concn. was <10 ppm. IFT

23

[Colour formation in nitrite-containing pork products.]

Halvarson, H.; Nilsson, R.

Livsmedelsteknik 15 (7) 293-295 (1973) [1 ref. Sv]

The relation between degree and rate of colour formation and nitrite conversion during the manufacture of pork sausages was studied. Samples containing 10-120 ppm nitrite and 0 or 700 ppm ascorbic acid were emulsified, and the contents of nitrite, total haem pigments and nitrosyl haem pigments were determined at 30°C (emulsion temp.) at intervals from 0 to 24 h. Results are given in tabular and graph (absorption spectra) form. The main conclusion was that the degree of colour formation was intensified by addition of ascorbic acid, as it caused 75-80% of the total haem pigment to be converted to nitrosyl haem pigment. A model experiment under practical conditions indicated that the nitrite could satisfactorily be reduced to 50 ppm or less (the theoretical lowest level was 20 ppm, although special care was then needed to avoid colour deficiency). HBr

24

[Nitrate and nitrite as preservatives for foods.]

[Lecture]

Tjaberg, T. B.

SIK Rapport No. 384, 21-43 (1975) [30 ref. No] [Norsk Inst. for Næringsmiddelforskning, As, Norway]

The use of nitrite and nitrate as preservatives in foods is discussed, with reference to: colour formation; flavour and aroma development; toxicity of nitrates and nitrites; the danger of nitrosamine formation; and the value of nitrite for control of *Clostridium botulinum* and other microorganisms. The inhibitory activity of nitrite against *Clostridia* in heated and non-heated systems is discussed, with reference to interaction of nitrite concn., pH, NaCl concn. and heat treatment. The possible formation of a Perigo-type inhibitor is also considered. [See FSTA (1977) 9 3E89.] AJDW

25

Formation of nitrosamines. III. Reaction products of glycoxyamine and sodium nitrate.

Yamamoto, M.; Yamada, T.; Tanimura, A.

Journal of the Food Hygienic Society of Japan [Shokuhin Eiseigaku Zasshi] 17 (2) 176-181

(1976) [20 ref. En] [Nat. Inst. of Hygienic Sci., Kamiyoga 1-chome, Setagaya-ku, Tokyo, Japan]

The major reaction product of glycoxyamine and sodium nitrite under acidic conditions was identified as carboxymethylnitrosourea.

Nitrosocyanamide was not detected. [See FSTA (1975) 7 8C304 for part II.] TM

26

Formation of nitrosamines. IV. Kinetical studies on the carboxymethylnitrosourea formation from glycoxyamine and sodium nitrite.

Yamada, T.; Yamamoto, M.; Tanimura, A.

Journal of the Food Hygienic Society of Japan [Shokuhin Eiseigaku Zasshi] 17 (2) 182-186

(1976) [19 ref. En] [Nat. Inst. of Hygienic Sci., Kamiyoga 1-chome, Setagaya-ku, Tokyo, Japan]

The initial rate of carboxymethylnitrosourea formation from glycoxyamine and sodium nitrite was studied at pH 2.5 and 37°C. The rate was proportional to the concn. of glycoxyamine and sodium nitrite. The effects of thiocyanate, citrate, tartrate, NaCl and ascorbate on the rate were also studied. TM

27

Water quality - the need for purification. [Lecture]

Goodall, J. B.

Chemistry and Industry No. 24, 1057-1060

(1976) [En] [Elga Products Ltd., Lane End, High Wycombe, Bucks., UK]

Water purification by ion-exchange, organic scavenging and reverse osmosis is described. The harmful effects of high nitrate concn. in water (corrosion of food cans, patchy pigmentation of cured meats and the health hazard of methaemoglobinaemia in infants) are briefly mentioned. Reverse osmosis will remove most trace organic materials that may be carcinogenic or hazardous to health, cause bad taste and odour, and spoil the appearance and keeping qualities of processed foods and drinks. AL

28

Some physiological and biochemical aspects of nitrogen assimilation in barley and wheat.

Rao, K. P.

Dissertation Abstracts International, B 37 (3)

1057: Order No. 76-21000 (1976) [En] [Univ. of California, Davis, California, USA]

The induction, degradation and energetics of the nitrate transport system in barley were studied. Further studies tested genetic variability in the capacity to assimilate N and various factors which

influence the accumulation of grain protein. This investigation used 2 genotypes, Anza and UC44-111, of spring wheat. Anza had higher leaf nitrate content and lower nitrate absorption capacity, in vitro nitrate reductase activity and in vivo nitrate reduction than UC44-111. These differences, however, were reflected in grain or protein yields. Possible relationships between nitrate absorption and its reduction and the accumulation of grain protein are discussed. JA

29

[The formation of cooked cured meat color and residual amount of nitrite in the processing of emulsion type sausages.]

Kagami, A.; Hirano, M.; Morita, S.

Japanese Journal of Zootechnical Science [Nihon Chikusan Gakkai-ho] 47 (10) 599-601 (1976) [5 ref. Ja]

30

The effect of curing salt concentration on the microbiological and organoleptic stability of bacon. [Lecture]

Gozdz, W.; Borys, A.

Proceedings of the European Meeting of Meat Research Workers No. 21, 159-161 (1975) [15 ref. En] [Polish Meat Res. Inst., Warsaw, Poland]

The effects of curing salt concn. (50, 100 or 200 ppm NaNO_2 , 2, 3 or 4% NaCl) and packaging on the outgrowth of the indigenous microflora of Wiltshire-style bacon were studied. It was found that, in vacuum-packaged bacon, NaNO_2 and NaCl in the concn. range studied significantly inhibited the microflora. Nitrite was a more potent bacteriostatic agent than NaCl ; its action was noticeable throughout storage for ≤ 21 days, although nitrite concn. decreased. In non-vacuum-packaged bacon, even 200 ppm NaNO_2 + 4% NaCl did not adequately inhibit the microflora of bacon; the microbiological and organoleptic stability of vacuum-packaged bacon were good even at the lowest curing salt concn. studied. [See FSTA (1977) 9 4S605.] AS

31

[The state and availability for nitrosamine formation of nitrite in meat products.] [Lecture]

Frouin, A.; Jondeau, D.; Thenot, M.

Proceedings of the European Meeting of Meat Research Workers No. 21, 200-202 (1975) [11 ref. Fr, en, de, ru] [Societe Olida & Caby Associes, 50 Rue Raspail, 92304 Levallois, Perret, France]

On the basis of data for the pH and redox potential of meat products, it is calculated that added nitrite is normally present as NO in meat products. Fixing of this NO by groups present in meat (e.g. SH, OH) is briefly considered; studies were conducted (using the Griess method for detn. of NO) on binding of NO by numerous meat constituents (organic acids, amines, ascorbate, imidazole, cysteine, glutathione, water, glycerol,

sucrose). Tables of results are given, and discussed in relation to formation of nitrosamines and Perigo-type inhibitors in meat products. [See FSTA (1977) 9 4S605.] AJDW

32

Formation and stability of nitrosopigments in raw-dried sausages depending on the composition of the salting mixtures. [Lecture]

Nestorov, N.; Dилова, N.; Grozdanov, A.;

Djevisov[Dzhevizov], S.; Kiseva, R.

Proceedings of the European Meeting of Meat Research Workers No. 21, 203-205 (1975) [11 ref. En, de, fr, ru] [Meat Ind. Inst., Sofia, Bulgaria]

Studies were conducted on the nitrosopigment, NO_3^- and NO_2^- contents, colour, pH, etc. of Panaggiurska Lukanka sausages made with (i) 1000 mg KNO_3/kg ; (ii) 250 mg KNO_3/kg plus an unspecified amount of sodium isoascorbate; (iii) 80 mg NaNO_2/kg ; or (iv) 80 mg NaNO_2/kg plus 500 mg sodium isoascorbate/kg. Changes during ripening for ≤ 30 days were studied. A table and a graph of results are given. pH decreased sharply during the first 4 days of ripening, underwent a further slow decrease up to day 10-12, then increased slowly. Nitrate concn. in all samples decreased slowly; nitrite content in (ii), (iii) and (iv) decreased during ripening, whereas nitrite concn. in (i) increased rapidly in the first few days and then remained approx. constant. Nitrosomyoglobin concn. increased rapidly during the first 4 days of ripening, (i) giving the highest concn. during this period. After this, nitrosomyoglobin concn. remained constant or decreased slightly; during this period, (iv) gave the highest nitrosomyoglobin concn. Colour stability of the product is briefly considered; (iv) gave the best and (iii) the poorest colour stability. [See FSTA (1977) 9 4S605.] AJDW

33

The effect of nitrite and certain other food additives on the quality of Finnish cooked sausage. [Lecture]

Nurmi, E.; Raevuori, M.; Hill, P.

Proceedings of the European Meeting of Meat Research Workers No. 21, 209-211 (1975) [10 ref. En, de] [State Vet. Med. Inst., Hämeentie 57, 00550 Helsinki 55, Finland]

Effects of various additives on the quality of Finnish cooked beef/pork sausages were studied. Additives tested (singly or in combination) were NaNO_2 , sodium erythorbate, citric acid and glucono- δ -lactone. The organoleptic properties, pH, bacteriological quality and residual nitrite content of the products were determined; tables of results are given. Nitrite is essential for normal colour development; erythorbate + nitrite gives excellent colour formation. Glucono- δ -lactone and citrate may also improve colour formation and/or stability. Nitrite was also essential for the cured flavour of the product; use in combination with erythorbate and glucono- δ -lactone further improved flavour. Antibacterial effects of added nitrite were enhanced by added erythorbate, alone

or in combination with citric acid. In samples in which only nitrite was added, the residual nitrite level in the ready-to-eat product was approx. 60% of the original concn. Addition of erythorbate + citrate reduces this value to approx. 50%; addition of glucono- δ -lactone further reduces residual nitrite concn. [See FSTA (1977) 9 4S605.] AJDW

34

Wiltshire curing with and without nitrate. II. Vacuum packed collar bacon and vacuum packed bacon from pigs with high ultimate pH.

Taylor, A. A.; Shaw, B. G.; Jolley, P. D. *Journal of Food Technology* 11 (6) 589-597 (1976) [4 ref. En] [Meat Res. Inst., Langford, Bristol, UK]

The storage life of vacuum packed unsmoked bacons produced by a factory Wiltshire process from brines containing nitrite with and without nitrate was studied at 5° and 15° C. Whilst collar bacon produced from typical bacon pigs and containing 76-129 ppm nitrite and approx. 5% salt kept slightly better when it also contained 538-568 ppm nitrate, no consistent benefit was noted when the nitrate concn. was 196-204 ppm. Collar and back bacons with similar concn. of nitrite and salt and produced from pigs in which the ultimate pH in the longissimus dorsi was ≥ 6.0 kept better when they also contained approx. 600 ppm nitrate. It is suggested that the benefit of nitrate in these bacons is due to the inhibition of bacterial growth by increased concn. of nitrite produced from nitrate in relatively high pH muscles. [See FSTA (1975) 7 10S1359 for part I.] AS

35

[Studies on the potential for reduction of residual nitrite contents in Brühwurst sausages.]

Untersuchungen über Reduzierungsmöglichkeiten des Restnitritgehaltes in Brühwürsten. [Thesis] Oltmer, V.

110pp. (1975) [58 ref. De, en] Hanover, Federal Republic of Germany; Tierärztliche Hochschule

Studies on minimization of the residual nitrite concn. of Brühwurst cooked smoked sausages are described. Variables studied were: added nitrite concn. (0.4 or 0.6% NaNO₂, calculated on the basis of the NaCl content of the product); added ascorbic acid (0 or 0.3%); and added haemoglobin ($\leq 5\%$). Effects on residual nitrite concn. ≤ 7 days after manufacture were determined; tables of results are given. The initial nitrite concn. of 0.4% gives a 6% reduction in residual nitrite concn., as compared to the higher initial nitrite concn. Addition of ascorbic acid reduces residual nitrite concn. by approx. 11%; added haemoglobin reduces residual nitrite concn. by approx. 3.75% for each 1% added haemoglobin. Addition of $\leq 4\%$ haemoglobin has no significant effect on the colour of the sausages. Use of these techniques in combination permits reduction of residual nitrite concn. by $\leq 30\%$. These results are discussed in relation to minimization of the danger of nitrosamine formation in cured meat products. AJDW

36

[Determination of plant nutrients by specific electrodes.] Die Bestimmung von Pflanzennährstoffen mit Hilfe ionenselektiver Elektroden.

Schönhard, G.; Schenke, H.-D.

Landwirtschaftliche Forschung 29 (3/4) 254-267 (1976) [2 ref. De, en, fr] [Inst. für nichtparasitäre Pflanzenkrankheiten der Biol. Bundesanstalt, Königin-Luise-Strasse 19, 1000 Berlin (West) 33]

K⁺, Ca²⁺, Cl⁻ and NO₃⁻ were determined in 8 plant samples by using ion selective electrodes, and results confirmed by other methods or by addition of known standards. Results for Ca²⁺ and K⁺ (in apples, cabbage, endives, celery, cucumbers) agreed well with flame photometric detn. (except for 1 sample containing large amounts of Ca) and were not improved by adding Ca and Mg or Mg and K to standards, in amounts corresponding to the average concn. in plants. Mean values for Cl⁻ were about 20% higher than those obtained by the 'Chloride meter'. NO₃⁻ contents of $>0.5\%$ were confirmed by standard additions (sample wt. 2 g). For lower concn., larger sample wt. is recommended, or addition of known external standard. When large numbers of detn. are done, standard curves should be prepared both at the start and at the end of the analyses. RM

37

[Effect of trace nitrite ion on microbial growth. I. Study of the nitrite ion during koji making and its effect on fungal spore germination.]

Shimogishi, I.

Journal of the Society of Brewing, Japan [Nihon Jozo Kyokai Zasshi] 71 (4) 305-307 (1976) [9 ref. Ja] [Coll. of Mie, Tsu, Mie, Japan]

NO₂⁻ was found in traditionally prepared koji at 25 ppm after about 10 h incubation, while no NO₂⁻ was found in the koji made with *Aspergillus oryzae* W27. It was therefore presumed that production of NO₂⁻ was due to nitrate-reducing bacteria growing in ordinary koji. Germination of fungal spores was greatly delayed by high concn. of NO₂⁻. YN

38

[Chemical-analytical, physical and sensory studies of fresh 'Mettwurst'. I. The effect of various additives.] Chemisch-analytische, physikalische und sensorische Untersuchungen "Frischer Mettwurst". I. Der Einfluss verschiedener Zusatzstoffe.

Jöckel, J.; Weber, H.; Gerigk, K.; Grossklaus, D. *Archiv fuer Lebensmittelhygiene* 27 (4) 130-134 (1976) [19 ref. De, en] [Inst. für Veterinärmed. (Robert von Ostertag-Inst.), Bundesgesundheitsamt, 1000 Berlin (West) 33]

The 6 batches of 'Mettwurst' described in the previous paper [see FSTA (1977) 9 1S12] were examined at intervals for ≤ 33 days for reddening, fat, protein and salt contents, by penetrometer (Fa. Sommer & Runge) and by sensory assessment. Sausages with added glucose (G) or glucono- δ -lactone (L) retained their quality unchanged throughout; those with L showed pH values < 5.6

and reddening values > 50% already 1 day after manufacture, while those with G reached these values only after 6 days, and both G and L sausages had the sensory characteristics typical of soft raw sausage. Of the batches made without G or L, that with the lowest nitrite curing salt concn. was found spoilt on day 19, while the others kept well throughout; they had about the same sensory quality as G or L sausages but had higher pH (5.8-5.9) and less developed reddening (approx. 40%).
SKK

39

Update on nitrite, nitrate and nitrosamines. [Lecture]

Greenberg, R. A.

Proceedings of the Meat Industry Research Conference pp. 71-76 (1975) [1 ref. En] [Swift & Co., Oak Brook, Illinois 60521, USA]

Research conducted by the USDA is described, in which samples of 'country style' ham were purchased at 4 locations, analysed for nitrate and nitrite and, after frying in $\frac{1}{4}$ inch slices for 6 min/side at 340° F, for N-nitrosopyrrolidine. The data show no correlation between NO_3^- , NO_2^- and/or nitrosopyrrolidine content. In commercial plant tests, increasing erythorbate to 1000 ppm and limiting nitrite to 120 ppm has had a measurable effect in reducing nitrosopyrrolidine levels in fried bacon. [See FSTA (1977) 9 5S845.] JRR

40

[Analytical problems in meat products control.] [Lecture]

Bocca, A.; Fontana, A.; Stacchini, A.

Bollettino dei Laboratori Chimici Provinciali 27 (7) 215-224 (1976) [11 ref. It] [Istituto Superiore di Sanita, Rome, Italy]

Problems of analysis and interpretation in control of meat additives are discussed in relation to NO_3^- , NO_2^- and polyphosphates. Tables and diagrams show that no diethylnitrosamine was found in beef or pork after addition of ≤ 500 mg NaNO_2 /kg and 3 days refrigerated storage, or cooking; traces of dimethylnitrosamine were detected after addition of 500 mg NaNO_2 /kg, and also after addition of 250 mg/kg and 6 months storage. NO_2^- and NO_3^- concn. remained constant during 12 days storage of fresh meat at 4° C but decreased after 4 days at 29° C. In cooked meat, NO_3^- concn. fell by > 60% during 3 months storage. No correlation could be estimated between initial NO_2^- addition and the nitrosamine content of commercial products. Polyphosphate analysis is complicated by enzymic and chemical hydrolysis in meat, and the complex mixtures used. As the distinction of organic and monomeric and polymeric inorganic P is inconclusive, analysis can be limited to the detn. of total P, or the protein:P ratio. Foreign proteins (casein, soya) are best identified by TLC with densitometric detn. RM

41

Meat pickling.

Canada Packers Ltd.

British Patent 1 450 307 (1976) [En]

Meat pickling solutions contain alkyl nitrites with 2-8 C atoms to reduce the hazard of nitrosamine formation during cooking. IFT

42

[Determination of nitrite and nitrate in meat products.] [Lecture]

Benassi, R.

Bollettino dei Laboratori Chimici Provinciali 27

(7) 225-235 (1976) [26 ref. It] [Lab. Chimico Provinciale di Reggio Emilia, Italy]

The difficulties of detn. of NO_2^- and NO_3^- added during production of meat products are discussed. Analytical problems due to uneven distribution in the products, and to the decrease in concn. during storage were investigated: in cooked, minced and homogenized ham stored at +5° C, NO_3^- concn. fell from 700 mg/kg to practically nil within 2 wk, while NO_2^- increased to > 400 mg/kg after 2 wk, to fall to trace amounts at the end of 25 days. 5 replicate samples showed that the salts were uniformly distributed in various sausage mixtures, but unevenly distributed in non-comminuted products (cooked ham or shoulder). Distribution was improved when cooked ham was injected with a multi-head syringe (instead of into a vein). At -20° C, both NO_3^- and NO_2^- concn. were maintained for 2-3 months. RM

43

[TLC identification and semiquantitative determination of nitrite and ammonium ions in aqueous model solutions.] Über eine dünnschichtchromatographische Identifizierungsmöglichkeit (semiquantitative Bestimmung) von Nitrit- und Ammonium-Ionen in wässrigen Modellösungen. Thielemann, H.

Zeitschrift fuer die Gesamte Hygiene und ihre Grenzgebiete 22 (9) 670-671 (1976) [De]

[Hygiene-Inst., Martin-Luther-Univ., Halle-Wittenberg, German Democratic Republic]

TLC methods for detn. of nitrite and ammonium ions in water (as indices of faecal contamination) are described. Nitrite may be separated using an ethanol/pyridine/water/conc. NH_3 system, nitrite flecks being identified by treatment of the developed chromatogram with α -naphthylamine and sulphanilic acid. Ammonium ions are separated using double-distilled water for development of the chromatogram, and identification of the ammonium ion flecks with Nessler's reagent. Detection limits for nitrite and ammonium ions on various plates are, respectively (μg): Kieselgel G, not given and 4; UV 254 prepared TLC sheets, 1 and 2; and FND cellulose prepared TLC sheets, 0.06 and 1. Limits for semiquantitative detn. are, for nitrite and ammonium ions respectively (μ): Kieselgel D, 4 and not given; UV 254 sheets, 4 and 20; and FND sheets, 0.8 and 20. IN

44

Comparison between an ultraviolet spectrophotometric procedure and the 2,4-xenolol method for the determination of nitrate in groundwater of low salinity.

Miles, D. L.; Espejo, C.

Analyst 102 (1211) 104-109 (1977) [25 ref. En] [Hydrogeological Dep., Inst. of Geological Sci., Exhibition Road, London SW7 2DE, UK]

Groundwaters provide almost 40% of the domestic water supply in England and Wales and the concn. of nitrate present has an important bearing on potability. A (i) UV spectrophotometric procedure for detn. of nitrate in groundwaters of low salinity has been investigated and compared with (ii) the recommended 2,4-xenolol method. The cations in typical groundwaters do not interfere in procedure (i), and interference from high nitrite levels ($>20 \mu\text{g/l}$. of nitrite-N in samples diluted to contain 0-1.0 mg/l. of nitrate-N) is overcome by addition of 1% sulphamic acid solution to give a final sulphamic acid concn. of 0.1% mol/vol. Absorbances were measured at 206 nm in 1.0-cm cells. The 2 methods showed good agreement for a number of groundwater samples, as well as 3 samples of river Thames water. Procedure (i) offers a rapid (≤ 30 samples/h) and sensitive method for nitrate detn. in such waters, which generally have low organic matter content, particularly where the sample vol. is limited. AL

45

[Nitrates in pome and stone fruits.] [Lecture]

Huguet, C.; Bonafous, M.; Ducailar, G.

Fruits 31 (7/8) 483-487 (1976) [20 ref. Fr, de, en, es, ru] [Dep. d'Agron, INRA, 84000 Montfavet, France]

The effects of mineral nutrition, growth retardants and maturity on NO_3^- concn. in apples, pears, cherries and peaches were examined. While Ca deficiency caused an increase of NO_3^- and a decrease in maturity (measured by total sugar accumulation), the overall levels were very low (about 6-8 mg/l. extracted fruit juice). Application of growth retardant (Alar 85) increased the NO_3^- concn. in cherries from 7.4 to 11.5 mg/l. Under normal physiological conditions, the activity of nitrate reductase prevented the accumulation of NO_3^- in fruits. RM

46

[Nitrate and nitrite-nitrogen contents of cows' and human milk.]

Sukegawa, K.; Matsumoto, T.

Journal of the Japanese Society of Food and Nutrition [Eiyo to Shokuryo] 28 (7) 389-393 (1975) [16 ref. Ja, en] [Dep. of Dairy Sci., Obihiro Zootech. Univ., Obihiro, Hokkaido, Japan]

Nitrite contents in cows' milk, milk products and human milk were determined colorimetrically at 540 nm by a diazo-coupling reaction with sulphanilamide and N-(1-naphthyl)ethylenediamine dihydrochloride in a slightly acid solution, and nitrate contents were determined as nitrite after

reduction by passing through a Cd column (1.8×10 cm; flow rate 4.6 ml/min). Nitrate N levels in cows' milk varied from 0.2 to 0.5 ppm, but high nitrate levels (1-5 ppm) were found in human milk. No nitrite N (<0.01 ppm) could be detected in cows' milk. AS

47

[State of 'nitrite' in meat products.] [Lecture]

Frouin, A.; Thenot, M.

Proceedings of the European Meeting of Meat Research Workers No. 22, F9:1-F9:6 (1976) [40 ref. Fr, en, de, ru] [Service de Recherche de la Societe Olida et Caby Ass., 50 Rue Raspail 92304, Levallois-Perret, France]

Na_2SO_3 , in alkaline solution, gives a photometric absorption plot with peaks at 263 nm when the solution is pure, 268 and 274.5 nm when NO is present, 263 and 300 nm when NO_3^- is present, and 263 and 350 nm when NO_2^- is present. Using this reaction on cooked ham and dry sausage extracts, previous theoretical studies are corroborated, showing that 'nitrite' is in the form of nitrogen monoxide (NO) in pork. This result is corroborated by means of Zambelli's reagent. This reagent does not give any characteristic peak with NO_2^- when the initial reaction stage, in acid solution, is suppressed, but it gives a peak with NO in the same conditions. Therefore, it may be calculated that nearly all the NO_2^- is decomposed to NO and fixed under this form in meat products. This suggests that nitrosamines are formed only when high nitrite contents saturate the fixation capacities of NO by meat, or with high temp. which release NO and permit its reoxidation, giving NO_2^- . Therefore, a new approach to the problems of quantitative analysis and toxicity of nitrite is necessary, taking account of these aspects. [See FSTA (1977) 9 6S988.] AS

48

Method for the extraction of nitrite from meat products.

Perryman, D. L.

Laboratory Practice 26 (3) 186-187 (1977) [1 ref. En] [Health Commission of NSW, Div. of Analytical Lab., Joseph Street, Lidcombe NSW 2141, Australia]

The procedure is described for extraction of nitrite from meat products in an apparatus in which the sample is contained in a plastics bag and is pounded by 2 moving paddles. The apparatus is quiet, and achieves satisfactory extraction in 30 s. Use of a fresh plastics bag for each sample eliminates washing of a beaker. The procedure up to filtration takes 35 min with the paddle homogenizer vs. 2.5 h for the AOAC method; no significant differences in results were found between the methods. AL

49

Changes in the contents of sulphhydryl groups and protein-bound nitrites in raw dried sausages.

[Lecture]

Dilova, N.; Nestorov, N.; Grozdanov, A.; Dikova, G.

Proceedings of the European Meeting of Meat Research Workers No. 22, G1:1-G1:5 (1976) [7 ref. En, fr, de, ru] [Meat Tech. Res. Inst., Sofia, Bulgaria]

Changes in the contents of SH groups and protein-bound nitrites (PBN) in 'Panagiurska Loukanka' dry sausages during ripening for ≤ 31 days are discussed. Batches of sausages made with (i) 400 mg KNO_3/kg , (ii) 250 mg $\text{KNO}_3 + 120 \text{ mg NaNO}_2/\text{kg}$, (iii) 120 mg NaNO_2/kg or (iv) 120 mg $\text{NaNO}_2 + 500 \text{ mg sodium isoascorbate/kg}$ were studied. Tables and graphs of results are given. In general, SH group concn. decreases for the first few days of ripening, rises to a max. at approx. day 10, then decreases again throughout ripening. PBN concn. increased during the first 3-6 days of ripening, then decreased to their initial level or slightly lower and remained approx. constant. (i) and (ii) gave lower SH group concn. and higher PBN group concn. than (iii) or (iv). It is concluded that only a negligible part of the total SH groups bind nitrite. It is suggested that concn. of SH groups and PBN have little effect on nitrosopigment stability. [See FSTA (1977) 9 6S988.] AJDW

50

[Effects of glucono- δ -lactone on the colour and colour stability of cooked comminuted sausages.]

[Lecture]

Duda, Z.; Mielnik, J.; Nowak, A.; Pezacki, W. *Proceedings of the European Meeting of Meat Research Workers* No. 22, F5:1-F5:8 (1976) [28 ref. Ru, en, de, fr] [Acad. of Agric., Wroclaw, Poland]

Cooked comminuted sausages were manufactured with addition of glucono- δ -lactone (GDL) using meat of two different periods of post-mortem ageing (i.e. 24 and 144 h), cured with NaNO_2 . The addition of 0.3 or 0.7% of GDL in relation to meat tissue does not influence colour formation and colour stability of the final product. Application of GDL permits reduction of amount of NaNO_2 used 8-11 fold, i.e. to 7 mg%, without undesired influence on the colour and colour stability of experimental sausages. Using NaNO_2

and GDL the processing time could be reduced 9 fold in relation to period required when similar product is processed with NaNO_3 or KNO_3 as curing agents. Simultaneous use of GDL and reduced amount of NaNO_2 has resulted in significantly lower residual nitrite concn. in the final product. Addition of 0.3% and particularly 0.5% of GDL improves organoleptic characteristics of sausages, while addition of 0.7% of GDL shows detrimental effects on structural characteristics of both sausage emulsion and prepared sausages. Ageing of meat has no influence on technological and organoleptic characteristics of the experimental sausages. [See FSTA (1977) 9 6S988.] AS

51

Flavor components of cured pork products.

[Lecture]

Heidemann, F. H.; Wismer-Pedersen, J.

Proceedings of the European Meeting of Meat Research Workers No. 22, A6:1-A6:6 (1976) [7 ref. En, fr, de, ru] [Dep. of Meat Tech., Royal Vet. & Agric. Univ., Howitzvej 11, DK-2000 Copenhagen F, Denmark]

61 volatile components were separated and characterized from nitrite-cured pork after heat treatment. Of these 14 were aldehydes, 6 ketones, 11 S compounds and 5 furans. 20 of these compounds have not previously been identified from pork products. The concn. of the characterized compounds were compared with their threshold concn. of perception, and 10 S compounds, 8 aldehydes, 2 ketones and 2 furans considered of importance as flavour compounds. The components, isolated from headspace above heated meat or by concn. of vacuum distillates, were separated by GLC, and characterized partly by refraction time, partly by MS. All the identified components were isolated from fresh as well as cured meat but in different concn. With regard to S compounds, the most volatile, like H_2S and methyl mercaptan, were most abundant in vapours from fresh meat, while the less volatile disulphides were at their highest concn. in vapours from cured meat. Short chain carbonyls (C2-C5) were at their highest concn. over cured meat and medium chain (above C5) carbonyls over fresh meat. [See FSTA (1977) 9 6S988.] AS

52

[Nitrates and nitrites: necessary revision of basic conceptions of analytical methods.]

Frouin, A.; Thenot, M.; Jondeau, D.; Patte, K.; Barraud, C.; Grimault, M. L.; Durand, P.; Venduvre, J.-L.

Annales des Falsifications et de l'Expertise Chimique 69 (743/744) 629-635 (1976) [42 ref. Fr, en]

The common assumption that added nitrites are oxidized to nitrates in meat products is questioned. Theoretical considerations (presented) render this unlikely and a converse reduction to NO is more probable. Analyses were made of 30 sausage products and 6 cooked hams with a known original nitrite contribution; 2 highly sensitive methods failed to reveal any nitrate in the meats. Other

methods of analysis were examined. NO was detected by the colour reaction with sulphanilic acid/phenol (negative with NO_2^- and NO_3^- ions); NO (but not NO_2^-) is also volatile by distillation at 40°C and 0.2 mm Hg. Total NO + NO_2^- ions can be detected by the antipyrine method; both were present in meats prepared with added pure nitrite, and some additional nitrite is formed from the meat itself. NO is only slightly soluble in water but no significant amounts of NO gas were released to the atm. It is concluded that nearly all added nitrite is reduced to NO, which is bound by meat components and retained. Standard analytical

methods for nitrites may give misleading results and chemical knowledge of compounds of N and O is inadequate (including possible formation of toxic NO_2). ELC

53

[Investigations on use of starter cultures in Frankfurter-type sausages.] Untersuchungen über die Verwendungsmöglichkeiten von Starterkulturen bei Brühwurst.

Petäjä, E.

Fleischwirtschaft 57 (1) 109-112 (1977) [2 ref. De, en, fr] [Univ. Helsinki, Inst. für Fleischtech., Viikin Koetila, 00710 Helsinki 71, Finland]

Frankfurter-type sausages were prepared with combinations of low levels of KNO_3 (50, 100 and 250 ppm) with vegetative, frozen or freeze-dried cultures of *Vibrio* 21 (*V. costicola*) or *Bactoferment* 21 (*Micrococcus*) at 10^6 - 10^8 /g. Tabulated results showed that good colour was obtained with 50 ppm KNO_3 + 10^8 /g vegetative *V. 21*, 100 ppm KNO_3 + 10^8 /g frozen *V21*, 50 ppm KNO_3 + 10^8 /g vegetative or frozen *Micrococcus*, 100 ppm KNO_3 + 10^8 /g (or 250 ppm KNO_3 + 5×10^7 /g) freeze-dried *Micrococcus*, 250 ppm KNO_3 + 10^7 /g freeze-dried *Micrococcus* allowed to act overnight, combined vegetative *V21* and *Micrococcus* (total 10^8 /g) + 30-80 ppm KNO_3 , and with many bacterial preparations if allowed to act overnight at $+8^\circ\text{C}$. Residual NO_2^- was < 20 ppm in most sausages prepared with ≤ 100 ppm KNO_3 . Flavour was better than the control in most cases. Results suggest an economic method for manufacturing Frankfurter-type sausages by using 250 ppm KNO_3 plus micrococci at a count of 10^7 /g, allowed to act overnight. [See also FSTA (1973) 5 11S1315.] RM

54

[The effect of vacuum on ham brining.]

Dzoljic, D.; Stamenkovic, T.; Loncar, A.

Tehnologija Mesa 17 (2) 38-41 (1976) [45 ref. Sh] [Jugoslavenskii Inst. za Tehnologiju Mesa, Belgrade, Yugoslavia]

Hams of meat-type pigs were (i) injected with brine using a pickle injector, (ii) left hams injected as (i) and tenderized immediately for 51 min by mechanical kneading and again for 51 min 19 h after injection, and (iii) right hams were tenderized as (ii) immediately after injection and then $3 \times$ for 17 min each time every 6 h 31 min after beginning of injection. Mechanical treatment of (ii) and (iii) was carried out under reduced pressure. Biceps femoris and quadriceps femoris muscles of (i)-(iii) were examined for % myoglobin conversion to nitrosomyoglobin and nitrite content 14 and 20 h after brine injection. (i)-(iii) hams pasteurized in cans were assessed organoleptically. It is concluded from tabulated and graphically presented results that (ii) and (iii) procedures promoted nitrosomyoglobin formation and nitrite breakdown in comparison with (i) and resulted in better organoleptic quality of preserved hams; and that (iii) was superior to (ii) in these respects. SKK

55

Nitrosamines in foodstuffs. [Review]

Crosby, N. T.

Residue Reviews 64, 77-135 (1976) [many ref. En] [Dep. of Ind., Lab. of the Gov. Chem., Cornwall House, Stamford Street, London SE1 9NQ, UK]

This review examines: the role of NO_3^- and NO_2^- in meat curing; the fate of added NO_2^- ; chemical and biological properties of N-nitrosamines; occurrence and interactions of precursor materials in the environment; analytical methods developed to assess the levels of nitrosamines in foods (isolation, cleanup and concn., identification and detn.); occurrence in foods (fish and meat products); and non-volatile and C-nitroso compounds. Attention is confined mainly to the most recent work. RM

56

A nitrosamide-specific detector for use with high-pressure liquid chromatography.

Singer, G. M.; Singer, S. S.; Schmidt, D. G.

Journal of Chromatography 133 (1) 59-66 (1977) [6 ref. En] [Carcinogenesis Program, Biol. Div., Oak Ridge Nat. Lab., Oak Ridge, Tennessee 37830, USA]

A highly specific automated method for identification of nitrosamides has been developed for use in conjunction with reversed-phase high-pressure liquid chromatography. The method is based on the well-known Griess reagent, and is capable of sensitivities of 0.5 nmol of injected nitrosamide in most cases. The method may be used for analysis of nitrite, nitrosamides, nitrosocarbamates, and alkyl nitrites [in e.g. biological materials]. AS

57

'Translocation'-toxicity ought to be considered in tests for pesticide registration.

Schuphan, W.

Qualitas Plantarum - Plant Foods for Human Nutrition 26 (4) 321-329 (1976) [35 ref. En] [Heidestrasse 9, D 6222 Geisenheim/Rhein, Federal Republic of Germany]

Objections are raised against the present mode of action in the toxicological evaluation of new pesticides which are subsequently introduced commercially. 'Translocation' toxicity, i.e. the effects of interaction between pesticide, herbicide or plant regulator with plant compounds and metabolism, should be taken into account. Reference is made to suppression of carotene synthesis in carrot roots by insecticides, 2,4-D and 2,4,5-T in milk (via treated fodder), high nitrate content in carrots following herbicide treatment, and the conjugation of 2,4-D hydroxylated metabolites in beans and corn. AL

58

Nitrate and nitrite contents of vegetables and fruit in Ireland.

Kenny, T. A.; Walshe, P. E.

Irish Journal of Agricultural Research 14 (3) 349-355 (1975) [9 ref. En] [An Foras Taluntais, Kinsealy Res. Cent., Malahide Road, Dublin 5, Irish Republic]

12 common fresh vegetables and 3 fruits, taken from 3 sources (a wholesaler in Dublin market, a pre-packing station and a commercial holding), were tested for nitrate and nitrite contents in April-May, 1974 and Nov. 1974-Jan. 1975. Nitrate was reduced to NO_2 by shaking with Cd and the NO_2 was measured colorimetrically. Recovery of $\text{NO}_3\text{-N}$ was 99.7%, $\text{SD} \pm 2.7$. $\text{NO}_3\text{-N}$ contents were: 0-50 ppm in apples, Brussels sprouts, cauliflower, French beans, parsnips, peas, potatoes, onions and tomatoes; 10-295 ppm in carrots, cabbage and cucumbers; 50-570 ppm in rhubarb and spinach; and 280-1000 ppm in celery and lettuce. Nitrite was absent from all samples except spinach (0-3 ppm). $\text{NO}_3\text{-N}$ content of cooked carrots and celery was reduced by 40.1% and 55.5% respectively compared with fresh samples. $\text{NO}_3\text{-N}$ levels in samples of lettuce, celery, spinach and rhubarb would make them unsafe for use in infant foods.

AL

59

[Improvement in the keeping quality of ichiyazuke by pH adjustment.]

Kaneko, K.

Up-to-Date Food Processing [Shokuhin Kaihatsu] 10 (9) 33-39 (1975) [Ja] [Koriyama Women's Univ., Koriyama, Fukushima, Japan]

Ichi-yazuke is a pickle prepared from Chinese cabbage (*Brassica pekinensis*), turnips (*B. rapa*), Japanese radish root (*B. sativus* var. *macropodus*), cucumbers (*Cucumis sativus*) etc., and salted overnight. Commercial preparations of ichiyazuke were analysed for pH, NaCl, ascorbic acid, dehydroascorbic acid, and diketogulonic acid. About 37-74% of vitamin C was retained in ichiyazuke, but most part was in the form of dehydroascorbic acid. Ichiyazuke contained 8-23 ppm NO_2 , or 100-300 times as much as in the raw vegetables used in its preparation. It was found that this NO_2 content could be decreased by adjusting the pH below 3.5 by adding acetic acid. This treatment was also effective in increasing the shelf life to 7 days. Lactic acid was not as effective as acetic. SKa

60

[Nitrate and protein contents of lettuce (*Lactuca sativa* var. *capitata*, Butterhead) grown under different conditions.]

Hansen, H.

Tidsskrift for Planteavl 80 (3) 370-380 (1976) [16 ref. Da, en] [Statens Forsogssta., Aarslev, Denmark]

In a series of 6 experiments, lettuce was grown under various conditions in the open and in the greenhouse, and the contents of nitrate and protein were determined. A very wide range of concn. were found: nitrate varied from 12 826 to 172 ppm (fresh wt.), and protein from 2.27 to 0.20%; the DM content ranged from 8.1 to 3.63%. No single factor (e.g. fertilization, time of yr) could be isolated as the major contributing factor in the variations. The horticultural implications of the findings are discussed in some detail. HBr

61

[Nitrate determination in raw spinach and commercially-produced ready-to-use baby food.]

Nitratuntersuchungen in Rohspinat und industrieller Säuglingsfertiernahrung. Schütt, I.

Nahrung 21 (1) 61-67 (1977) [16 ref. De, en, ru] [Hygiene-Inst. des Bezirkes Schwerin, Grosses Moor 36, Schwerin, German Democratic Republic]

Systematic studies on the nitrate content of fresh spinach and spinach-based baby foods were conducted during the period 1972-1973. Tables of results are given. Nitrate contents of both fresh spinach and baby foods varied considerably; many samples had nitrate contents exceeding current legal max. values in the German Democratic Republic. Autumn-grown samples had especially-high nitrate concn. The need for further studies on factors influencing nitrate accumulation in spinach is briefly discussed. IN

62

[Effect of dried beet addition to ration of dairy cows fed on green feed from intensive nitrogen fertilization.]

Leonhard-Kluz, I.; Bielak, F.; Wierna, W.; Zyweczok, H.

Roczniki Naukowe Zootechniki 3 (2) 117-126 (1976) [13 ref. Pl, en, ru] [Samodzielna Pracownia Mleczarstwa, Inst. Zootech., Aleksandrowice, Poland]

2 matched groups (i) and (ii) of 10 Polish Red-and-White Lowland cows received daily/cow 80 kg green feed obtained from pastures fertilized with N at 100 kg/ha (during the preliminary 14-day and final 21-day periods), 240 kg/ha (during the 1st 28 days of the experimental period), and at 480 kg/ha (during the remaining 28 days of the experimental period). During the experimental period, (ii) received a daily supplement of 4 kg dried beet/cow (it is not stated whether it was fodder or sugar beet). Ration and milk contents of nitrates were determined every wk, and milk was also analysed for contents of urea, fat, TS, protein, Ca, P and Mg and renneting time. Green feed DM contained 0.032% nitrate N at the 100 kg N/ha level and 0.246% at the 480 kg N/ha level. Nitrate N content rose in (i) milk from 0.127 mg% to a max. of 0.300 mg% in the 2nd part of the experimental period, and then decreased to 0.242 mg%; in (ii), it was correspondingly 0.172, 0.290 and 0.218 mg%. Urea

content in milk ran approx. parallel for both groups, beginning at approx. 50-55 mg% in (i) and (ii), then falling to 41 and 20 mg% respectively, rising again to 70 and 40 mg% and falling finally to 30 and 17 mg%; (i)-(ii) differences were highly significant. There were no marked differences in other milk characteristics measured or in milk yield. No nitrites were detected in either milk. SKK

63

The use of nitrate in the manufacture of Gouda cheese. Lack of evidence of nitrosamine formation.

Goodhead, K.; Gough, T. A.; Webb, K. S.; Stadhouders, J.; Elgersma, R. H. C.

Netherlands Milk and Dairy Journal 30 (3/4) 207-221 (1976) [34 ref. En, nl] [Lab. of the Gov. Chemist, London, UK]

Gouda cheeses, made with the normal amount of added NaNO_3 (15 g/100 l. milk), were stored at 13°C and the nitrate and nitrite contents estimated after 24 h, 4 days and at weekly intervals during a 14 wk ripening period. The nitrate content decreased from an average of 56 mg/kg, immediately after preparation, to about 30 mg/kg after 6 wk; thereafter the decrease was much slower. The nitrite content of the cheeses was low, reaching a max. of 1 mg/kg after 2-3 wk and then falling to a steady value of 0.5 mg/kg after 4-5 wk. Additions of 20, 40 or 60 g NaNO_3 /100 l. milk resulted in higher levels of nitrite (up to 2.5 mg/kg) temporarily occurring in the cheese, but no accumulation of nitrite was observed. These same cheeses were analysed for nitrosamines. The results showed that, under the conditions described, the addition of normal amounts of nitrate during the manufacture of Gouda cheese did not lead to formation of detectable amounts of volatile nitrosamine during ripening. MEG

64

Gamma irradiation at $-30 \pm 10^\circ\text{C}$ of low level nitrite/nitrate ham.

Anellis, A.; Shattuck, E.; Latt, T.; Songpasertchai, S.; Rowley, D. B.; Ross, E. W., Jr.

Abstracts of the Annual Meeting of the American Society for Microbiology 76, 189 (1976) [En] [Natick Development Cent., Natick, Massachusetts 01760, USA]

An inoculated, irradiated ham pack study was conducted to establish the dose required to reduce the number of *Cl. botulinum* spores by a factor of 10^{12} . The ham contained 25 mg/kg of nitrite and 100 mg/kg of nitrate. Each can contained a mixture of 10^3 spores of each of 10 strains (5 type A and 5 type B). The cans were irradiated to various doses with ^{60}Co gamma rays at $-30 \pm 10^\circ\text{C}$, incubated for 6 months at $30 \pm 2^\circ\text{C}$, and examined for swelling and botulinal toxins and cells. The traditional 12D dose (an exponential death rate minus an initial shoulder) was 3.3 Mrad when computer on the basis of 10^7 spores/can, and 3.8 Mrad when assumed that each can of beef contained 10^6 spores of a single most resistant strain. Extreme Value

statistical analysis indicated that the spore death rate was neither a simple exponential nor a normal death rate but could be a shifted exponential (with an initial shoulder), Weibull or lognormal with a 12D equivalent of 3.0 Mrad if the spore level is 10^7 /can and 3.2 Mrad assuming 10^6 spores/can. A large number of cans had a mixture of types A and B toxins; many of these cans did not have the expected mixture of types A and B recoverable cells, but had only A or B cells. At 1.4 and 1.7 Mrad, type B cells predominated, but at 2.0 Mrad type A cells predominated. AS

65

Inhibition of nitrosamine formation in fried bacon by propyl gallate and L-ascorbyl palmitate.

Sen, N. P.; Donaldson, B.; Seaman, S.; Iyengar, J. R.; Miles, W. F.

Abstracts of Papers, American Chemical Society 170, AGFD 55 (1975) [En] [Food Res. Div., Health Protection Branch, Ottawa, Ontario K1A 0L2, Canada]

Treatment, just prior to frying, of normal nitrite-cured bacon with 1000 ppm of propyl gallate, piperazine, sodium ascorbate or ascorbyl palmitate markedly reduced the formation of nitrosopyrrolidine during cooking. Propyl gallate, piperazine and ascorbyl palmitate were more effective than sodium ascorbate in this respect. When nitrosoproline was added to lard or non-nitrite bacon (bacon prepared without nitrite) and the mixture cooked, formation of nitrosopyrrolidine was demonstrated but the yield (0.04-0.2%) was extremely low. Addition of the above-mentioned additives did not inhibit the formation of nitrosopyrrolidine from nitrosoproline. It was, therefore, concluded that these additives inhibit nitrosopyrrolidine formation during cooking of bacon by interfering with reactions other than the decarboxylation step of nitrosoproline. The possibility of using ascorbyl palmitate in cured bacon is discussed. AS

66

[Effects of reduced addition of nitrate and nitrite on the properties of dry sausage.] Der Einfluss von verringerten Nitrit- und Nitratzusätzen auf die Eigenschaften der Rohwurst.

Puolanne, E.

Journal of the Scientific Agricultural Society of Finland 49 (1) 1-106 (1977) [many ref. De, en, fi] [Inst. for Meat Tech., Univ. of Helsinki, Viiki, 00710 Helsinki 71, Finland]

A detailed description is given of an extensive series of studies on effects of reduction of added nitrite and nitrate concn. (0-800 ppm NaNO_2 , 0-1000 ppm KNO_3) on the quality of raw dry sausages. Other variables evaluated included effects of addition of ascorbate and related compounds, glucono- δ -lactone, glucose or starter cultures, ripening temp., nitrite:nitrate ratio, and the period for which the meat had been stored before processing. Quality aspects studied included

organoleptic properties, bacterial counts, residual nitrate and nitrite concn., pH, moisture, fat, NaCl and NO concn., a_w values, wt. losses, and survival of *Salmonella senftenberg* in the sausages. Tables and graphs of results are given. The results are discussed in detail. It is concluded that safe, good quality raw dry sausage can be made using 100 ppm NaNO_2 , 150 ppm KNO_3 , or 50 ppm NaNO_2 + 75 ppm KNO_3 . If nitrate and nitrite concn. are to be reduced to these levels, it is essential that glucono- δ -lactone or starter cultures are used to ensure rapid reduction of sausage pH to the required level (pH 4.8-5.3). AJDW

67

[Wet salting hams and shoulders. II. Manufacturing processes and action of nitrite during salting.] Flores, J.

Revista de Agroquímica y Tecnología de Alimentos 16 (4) 473-481 (1976) [24 ref. Es] [Inst. de Agroquímica y Tecnología de Alimentos, Valencia, Spain]

This review deals with manufacturing processes for cooked hams and shoulders, including: injection of brine; maceration (tumbling, by massaging or by impact); cooking; packaging in plastic films; and action of nitrite (colour formation, inhibition of bacterial growth, nitrosamine formation). [See FSTA (1977) 9 4S699 for part I.] RM

68

[Problems in the use of nitrite.] Probleme bei Verwendung von Nitrit.

Ingram, M.

Fleischwirtschaft 57 (2) 211-217 (1977) [22 ref. De] [Meat Res. Inst., Langford, Bristol BS18 7DY, UK]

This review deals with problems of NO_2^- use for curing Wiltshire-style bacon, with special reference to the vacuum-packed sliced product. Min. concn. necessary for satisfactory colour and flavour formation and for bacteriological safety are discussed and illustrated with data from previous publications and trials over many yr. Min. initial NaNO_2 concn. of ≥ 20 ppm was required for good colour, 50 ppm for bacon flavour formation. The bacteriostatic effect was shown to be enhanced by NaCl, ascorbic acid, low pH, low storage temp., and was dependent on initial level of contamination. Some results suggested the formation of inhibiting compounds ('Perigo factors') during heating of meat + NaNO_2 . Unpublished results showed 100-1000 μg dimethylamine and trimethylamine/kg bacon (not exceeded at any stage during production and storage) and no dimethyl or any other nitrosamine in raw bacon (limit of detection 1 $\mu\text{g}/\text{kg}$). When pork was enriched with 100 ppm dimethylamine, only 15 $\mu\text{g}/\text{kg}$ of dimethyl nitrosamine was found in the bacon after curing. Equimolar concn. of NO_2^- and ascorbic acid reduced nitrosamine formation by > 5 fold. No generally valid min. NO_2^- concn. for preserving cured meat products could be suggested. RM

69

[Water analysis. Determination of nitrite-N.]

Norway, Norges Standardiseringsforbund
Norwegian Standard NS 4744, 4pp. (1975) [3 ref. No]

The sample is adjusted to pH 1.5-2.0; any nitrite present reacts with sulphanilamide to form a diazo compound, which is then coupled with N-(1-naphthyl)-ethylenediamine to give an azo derivative, the concn. of which may be determined by spectrophotometry at 545 nm. Detection limit of this method is 1 μg nitrite/l. This standard corresponds to Danish Standard DS 222, Finnish Standard SFS 3029, and Swedish Standard SIS 02 81 32. AJDW

70

[Water analysis. Determination of total nitrite- plus nitrate-N.]

Norway, Norges Standardiseringsforbund
Norwegian Standard NS 4745, 7pp. (1975) [5 ref. No]

Nitrate present in the sample is reduced to nitrite by means of Cd amalgam. The total nitrite (i.e. that originally present plus that formed from nitrate) is then reacted (at pH 1.5-2.0) with sulphanilamide to form a diazo compound, which is then coupled with N-(1-naphthyl)-ethylenediamine to give an azo derivative which may be determined by spectrophotometry at 545 nm. The detection limit is approx. 5 $\mu\text{g}/\text{l}$. This standard corresponds to Danish Standard DS 223, Finnish Standard SFS 3030, and Swedish Standard SIS 02 81 33. AJDW

71

Dimethylnitrosamine formation in the gastro-intestinal tract of rats.

Hashimoto, S.; Yokokura, T.; Kawai, Y.; Mutai, M.
Food and Cosmetics Toxicology 14 (6) 553-556 (1976) [15 ref. En] [Yakult Inst. for Microbiological Res., 1796 Yaho, Kunitachi, Tokyo, Japan]

Experiments were carried out to demonstrate the formation of dimethylnitrosamine (DMNA) from dimethylamine (DMA) and nitrate in the digestive tract of rats as a result of the activity of the gastrointestinal bacteria. All the rats were fed a diet supplemented with 0.1% and 0.4% KNO_3 . 5 strains of DMNA-forming bacteria were administered to the rats in the experimental group but not to the control group. DMNA was detected in the contents of the stomach, small intestine and caecum of the rats in the former group but not of the controls. DMNA disappeared more rapidly from the upper part of the small intestine than from the stomach, lower part of the small intestine or caecum. VJG

72

Contamination of potable ground water supplies in rural areas.

Delfino, J. J.

Abstracts of Papers, American Chemical Society 173, ENV 37 (1977) [En] [Lab. of Hygiene, 465 Henry Mall, Univ. of Wisconsin, Madison, Wisconsin 53706, USA]

An extensive survey was made of nitrate concn. in rural Wisconsin wells. Almost 10% of 8000 wells tested showed nitrate N levels > 10 mg/l.; values ranged from < 0.02 to 140 mg/l. Old and shallow wells typically exceeded the 10 mg/l. standard set for public water systems. Farming activities appeared to be the cause of high nitrate levels. Another concern in rural areas is the impact of accidents involving hazardous chemicals, e.g. a train derailment resulted in a phenol spill that contaminated a number of private wells for > 2 yr. Phenol concn. ≤ 1130 mg/l. were observed in one well. AS

73

Influence of dietary nitrate on nitrite content of human saliva: possible relevance to in vivo formation of N-nitroso compounds.

Spiegelhalter, B.; Eisenbrand, G.; Preussman, R. *Food and Cosmetics Toxicology* 14 (6) 545-548 (1976) [21 ref. En] [Deutsches Krebsforschungszentrum, Inst. für Toxikol. & Chemotherapie, 69 Heidelberg 1, Federal Republic of Germany]

Vegetables and vegetable juices with concn. of nitrate between 27 and 4031 ppm were ingested by 11 volunteers in 30 experiments. Variations in nitrate and nitrite concn. in saliva were determined for ≤ 7 h at intervals of 30 or 60 min. Average nitrate concn. in saliva 1-2 h after a continental-type breakfast were 74 ± 50 (range 11-232) and 9 ± 5 (range 3-20) ppm, respectively. 30 min after ingestion of nitrate in the form of vegetable juice (red beet), the max. average concn. of nitrate and nitrite being reached after 1 and 1.2 h respectively. When nitrate was consumed in spinach or radish instead of vegetable juice, the increase of salivary nitrate and nitrite was much slower, the highest values being reached after 2-3 h. The increase in the amount of nitrate secreted by the salivary glands was found to depend directly on the amount of nitrate ingested. Nitrite concn. in saliva correlated directly with salivary nitrate content. This suggests that there is a direct relationship between the salivary nitrite concn. and the amounts of nitrate ingested in the diet. The average increase in nitrite concn. in the saliva was 20 ppm/100 mg nitrate ingested. The possible relevance of these findings to the endogenous formation of N-nitroso compounds in the gastro-intestinal tract is discussed. Tabulated data show the min., max., and/or mean values for nitrate concn. of 4 vegetable juices and 18 vegetables. VJG

74

The effect of nitrate intake on nitrite formation in human saliva.

Tannenbaum, S. R.; Weisman, M.; Fett, D. *Food and Cosmetics Toxicology* 14 (6) 549-552 (1976) [19 ref. En] [Dep. of Nutr. & Food Sci., Massachusetts Inst. of Tech., Cambridge, Massachusetts 02139, USA]

The effect of nitrate intake on the formation of salivary nitrite has been studied in a series of individuals using a commercial canned celery juice purchased in a local 'nature food' store as the source of nitrate. The celery juice contained 1200 mg NaNO_3 /l. Individuals consumed the juice in the morning, and timed samples of saliva were collected. All individuals responded to the celery juice with a large increase in salivary nitrite concn. which in the average individual consuming 200 ml of juice (240 mg NaNO_3) reached a max. concn. of several hundred ppm in 1-2 h and then decreased in approx. exponential fashion over 24 h to the initial base level. The extent of nitrite formation is related to the quantity of nitrate, to the concn. of the nitrate source and to the oral microflora. The possibility of inhibiting or estimating nitrite formation was investigated using 2 commercial bactericidal mouthwashes. The mouth wash was taken either 10 min before or 10 min after ingestion of the celery juice. Max. level of nitrate was depressed significantly and the time-course was markedly altered. [See also preceding abstr.] VJG

75

[Oxalate content and cation:anion balance of spinach plants as affected by the $\text{NO}_3:\text{NH}_4$ -ratio of the nutrient solution.] Oxalatgehalt und Kationen:Anionen Gleichgewicht von Spinatpflanzen in Abhängigkeit vom $\text{NO}_3:\text{NH}_4$ Verhältnis in der Nährlösung.

Merkel, D.

Landwirtschaftliche Forschung 28 (1) 34-40 (1975) [17 ref. De, en, fr] [LUF, 325 Hameln, Finkenborner Weg 1A, Federal Republic of Germany]

Spinach plants were grown in nutrient solutions containing 10 m-equiv. NO_3^- or $\text{NO}_3^- + \text{NH}_4^+$ -nitrogen/l.; the % $\text{NO}_3\text{-N}$ was 40, 70, 90 and 100% respectively. Increasing % of $\text{NO}_3\text{-N}$ resulted in the following changes in the ion contents of the leaves (m-equiv./100 g DM): the C-A value (i.e. the total organic anions) increased from 260 to 418 and oxalate from 154 to 286; water-soluble oxalate decreased from 55 to 50; the sum of cation increased from 377 to 495, mainly due to Mg and Ca; and NO_3^- remained almost unchanged; the sums of inorganic anions and of total N decreased; organic N decreased from 390 to 330. Spinach plants low in oxalate can be produced without loss of yield when $\text{NO}_3\text{-N}$ is almost equal to $\text{NH}_4\text{-N}$. The application of pure $\text{NO}_3\text{-N}$ leads to an undesirable high oxalate content. AS

76

Postharvest physiology: a practical science.

Brecht, P. E.; Tabacchi, M. H.

New York's Food and Life Sciences 9 (2) 3-6

(1976) [En] [Dep. of Vegetable Crops, Cornell Univ. Agric. Exp. Sta., Ithaca, New York 14853, USA]

3 areas of research into vegetable physiology postharvest are under investigation and are briefly reviewed. Maintenance of texture and sugar content of sweet corn is highly dependant on conditions of storage and transport; retention of sweetness is inversely correlated with postharvest time, temp., O₂ concn. and atmospheric pressure. Starch increases in corn stored badly, at the expense of the simple sugars, sucrose (63%), fructose and glucose (15-17%) and maltose (0.5-1%). A maturity index for sweet corn is being developed, taking account of chemical and organoleptic factors. Postharvest metabolism by plants of nitrate to nitrite occurs during storage at high temp., high RH and low O₂ levels. Spinach and lettuce contain no nitrite when held under 'ideal' conditions. Tomato ripening is being studied with reference to mutant lines (rin mutant) which do not ripen normally, and the effects of illumination on the formation of lycopene and β -carotene in the ripening fruit. JRR

77

[Nitrate formation in sugar factories, its changes during processing and its influence on alcohol and yeast production by molasses fermentation.]

Taygun, N.

Seker 26 (101) 24-66 (1976) [11 ref. Tr, en, de, fr]

Nitrate and nitrite contents in sugar juices, molasses, etc. are considered. Nitrite is formed in sugar juices by microbial metabolism of nitrates present in the juice. The nitrite does not decompose during juice clarification, and accumulates in the molasses. If SO₂ is added to the thin juice, potassium imido sulphate may be formed; this accumulates on the sugar crystals, and increases the ash content of the sugar. Warm raw juices extracted by the BMA diffusion system have a higher nitrite content than juices produced by cold systems. During first liming, nitrite formation continues up to pH 10.5; no increase in nitrite concn. occurs during clarification. The nitrite content of sugar crystals is dependent on crystallization conditions. Studies on effects of the nitrite concn. of beet molasses on yeast and alcohol formation during aerobic or anaerobic fermentation are described; numerous tables and graphs of results are given. The results show that alcohol yield decreases with increasing nitrite concn., reaching zero at a nitrite concn. of 400 mg/l. No effect of nitrite on yeast production was observed. [From En summ.] AJDW

78

[Nitrite and nitrate in smoked fish.]

Cantoni, C.; Renon, P.; Aubert, S. d'

Archivio Veterinario Italiano 27 (3/4) 57-59

(1976) [7 ref. It, en] [Istituto di Ispezione degli Alimenti di Origine Anim., Fac. di Med. Vet., Univ. degli Studi di Milano, Milan, Italy]

Nitrate and nitrite were determined in the flesh and/or skin of smoked (i) sturgeon (2 samples), (ii) salmon (5 samples), (iii) herring fillet (1 sample) and (iv) herring (1 sample). Ranges or single values (as appropriate) were, for nitrite and nitrate respectively (mg/kg): (i) flesh 1.3-1.4 and 11.7-14.6, skin 2.1-2.5 and 16.3-19.8; (ii) flesh 1-16 and 8.8-57.6; (iii) flesh 2.2 and 40.8; and (iv) flesh 1.8 and 44.4, skin 2.2 and 74.62. No nitrate or nitrite was present in non-smoked samples. AJDW

79

[Chemical composition of 'Sova Ham']

Finogenova, N. V.

Voprosy Pitaniya No. 2, 83 (1977) [Ru]

Analysis of samples of Yugoslav ham, imported into the USSR under the label 'Sova Ham, skinless, defatted with natural juices - gelatine added', revealed the following composition moisture, 72.2 \pm 1.2%; fat, 5.9 \pm 0.58%; protein (N \times 6.25), 17.7 \pm 0.85%; total ash, 4.2 \pm 0.35%; sodium chloride, 3.7 \pm 0.14%; nitrites, 1.64 \pm 0.40 mg/100 g. The salt content was in excess of the requirements (2.4-3.4%) while the nitrites were markedly low. HBr

80

Methods of test. Meat and meat products. VII. Determination of nitrate content.

United Kingdom, British Standards Institution

British Standard BS 4401:Part 7, 8pp. ISBN 0-580-09321-2 (1976) [En] Price £1.60 [2 Park Street, London W1A 2BS, UK]

A reference method is given for detn. of nitrate content of meat and all meat products other than those having an unusually high content of strongly reducing substances. The method involves extraction of a test portion with hot water, precipitation of proteins, filtration and reduction of the extracted nitrate to nitrite by metallic Cd. After development of a red colour by addition of sulphanilamide and N-1-naphthylethylenediamine dihydrochloride to the filtrate, photometric measurement is made at a wavelength of 538 nm. [See FSTA (1971) 3 6U405 for part VI.] AL

81

Method of test. Meat and meat products. VIII. Determination of nitrite content.

United Kingdom, British Standards Institution

British Standard BS 4401:Part 8, 4pp. ISBN 0-580-09341-7 (1976) [En] Price £1.20 [2 Park Street, London W1A 2BS, UK]

The method involves extraction of a test portion with hot water, precipitation of proteins, and filtration. After development of a red colour by addition of sulphanilamide and N-1-naphthylethylenediamine dihydrochloride to the filtrate, photometric measurement is carried out at a wavelength of 538 nm. The method is applicable to all meat products except those with an unusually high content of strongly reducing substances. AL

82

Colorimetric determination of nitrite from meat and other foods: an alternative colour reagent for the carcinogenic 1-naphthylamine and an improved extraction method.

Hilsheimer, R.; Harwig, J.

Canadian Institute of Food Science and Technology Journal 9 (4) 225-227 (1976) [8 ref. En] [Food Microbiol. Res. Div., Health Protection Branch, Health & Welfare Canada, Tunney's Pasture, Ottawa, Ontario K1A 0L2, Canada]

1-naphthol, 5-amino-2-naphthalene sulphonic acid (5-2 ANSA), 2-amino-1-naphthalene sulphonic acid, 4-amino-1-naphthalene sulphonic acid, 8-amino-1-naphthalene sulphonic acid (8-1 ANSA) and 2-naphthylamine-6-sulphonic acid were compared with 1-naphthylamine in terms of their suitability for azo dye formation in the colorimetric detn. of nitrite. Recovery studies were carried out using raw, canned luncheon meat (nitrite free), canned turkey stew, canned peas and boiled carrots and broccoli. An extraction time of 30 min was necessary to ensure consistent recovery from comminuted samples. 5-2 ANSA and 8-1 ANSA gave a colour reaction comparable in intensity to that of 1-naphthylamine, with max. absorption at 525 nm. Colour development was max. after 35 min, and stable for between 35 and 180 min; absorption was linearly proportional to NaNO_2 concn. over the range 3-40 $\mu\text{g}/50\text{ ml}$. 5-2 ANSA is recommended, because of better solubility. JRR

83

[Problems with nitrates in foods. Analysis of vegetables for nitrates, minerals and carotene.]

Astier-Dumas, M.

Annales d'Hygiene de Langue Francaise, Medecine et Nutrition 9 (1) 79-84, 87-90 (1973) [9 ref. Fr] [Cent. de Recherche Foch, 4, Ave. de l'Observatoire, 75006, Paris, France]

Data are given for concn. of nitrates in various vegetables: mean values and ranges (with number of samples in parentheses) were (mg/kg): raw carrots (30), 274 and 12.9-895; cress (20), 1017 and 449-2747; leaf beet (14), midribs 765 and 147-1440, and leaves 503 and 54-1278; cooked red beets (20), 1577 and 774-2978; cooked turnips (20), 258 and 32-903; cooked leeks (20), 121 and 23-290; cooked potatoes (32), 101 and 9-225; cooked spinach (30), 83 and 22-360; lettuce (27), 1514 and 678-2695; endive (7), 860 and 40-2800; escarole (10), 376 and 76-675; cos lettuce (4), 1679 and 349-2571; tomatoes (10), 7 and 0-47; radishes (4), 712 and 87-1568; and cucumbers (8), 100 and 17-414. Data are also given for concn. of nitrite, carotene, Fe, Mg and K in some of these vegetables. The toxicity of nitrites is discussed, together with factors influencing variations in the nitrate content of vegetables. AJDW

84

[Nitrate reduction capacity of *Micrococcus* M III and *Vibrio* 21.] Über das Nitratreduktionsvermögen der Stämme *Micrococcus* M III und *Vibrio* 21.

Puolanne, E.; Törmä, P.; Djedjeva[Dzhedzheva], G.

Lebensmittel-Wissenschaft und -Technologie 10 (1) 7-11 (1977) [17 ref. De, en] [Inst. für Fleischtech., Univ., 00710 Helsinki 71, Finland]

The nitrate-reducing capacity of the *Micrococcus* M III + *Vibrio* 21 starter [see FSTA (1976) 8 9S1682] and of its components was tested under different pH (4.6-8.0), temp. (2-55°C) and NaCl content (0.5-18%) conditions. The use of *Micrococcus* M III as raw sausage starter and of *Vibrio* 21 as raw ham starter is discussed from the viewpoint of the findings. SKK

85

[Effect of quantity of sodium nitrite added during curing on colour stability of canned pasteurized meat.]

Klossowska, B.

Roczniki Instytutu Przemysłu Miesnego i Tluszczowego 13 79-91 (1976) [17 ref. Pl, ru, en] [Inst. Przemysłu Miesnego i Tluszczowego, Warsaw, Poland]

In model experiments, lean muscles taken from hams held at 4-6°C for 24 h after slaughter and feed from fat and tendons were minced and blended with a curing mixture consisting of (kg/100 kg meat): 3.9 NaCl, 2.0 glucose, 0.05 sodium ascorbate and 0.5 polyphosphate, together with NaNO_2 to give (depending on treatment variant) a concn. of 0, 5, 10, 20, 40, 80, or 160 ppm in the mix. The mixes were sealed in 102.5 x 77 mm cans and heated to achieve a temp. rise in the centre at the rate of 1°C/4 min in the 40-48°C range and at the rate of 1°C/8 min in the 49-68°C range; the cans were cooled in running cold water for 2 h and stored for ≤ 9 months at 4-6°C. Colour of samples was evaluated by reflectance measurement at 540 and 640 nm using a Pye-Unicam spectrophotometer and calculation of dominant wavelength (DW), colour brightness and saturation with the chromatic component. It is concluded from tabulated and graphically-presented results that DW stability decreased drastically with increase in duration of storage; that addition of NaNO_2 increased DW stability only to a limiting value determined by duration of storage; that with NaNO_2 at approx. 50 ppm, DW stability reached 95% of the limiting value at a given duration of storage; and that duration of storage should be ≤ 3 months to ensure DW stability of 45% of the initial value. SKK

86

Nitrite inhibition of active transport and of respiration in *Pseudomonas aeruginosa*.

Rowe, J. J.; Hodge, T. W., III; Eagon, R. G. *Abstracts of the Annual Meeting of the American Society for Microbiology* 77, 223 (1977) [En] [Univ. of Georgia, Athens, Georgia, USA]

Nitrite is often incorporated in food products to enhance colour and to prevent bacterial growth. The mechanism of the inhibitory action of nitrite on bacterial systems is obscure. During studies on active transport of radioactive solutes by *Pseudomonas aeruginosa* using nitrogen oxides as terminal electron acceptors, it was observed that nitrite dramatically inhibited active transport at a concn. of ≥ 50 mM. Active transport of glucose and of gluconate in *P. aeruginosa* was inhibited 95% by 100 mM nitrite; but nitrite had no effect on the transport of glucose in *Streptococcus faecalis*, an organism lacking cytochromes. Measurement of O_2 uptake by suspensions of cells of *P. aeruginosa* in the presence and absence of nitrite revealed that respiration was also inhibited by nitrite. From these data it is postulated that nitrite inhibited active transport in *P. aeruginosa* by inhibiting electron flow which is required to energize active transport. AS

87

Mutagenic activity of nitrite-treated foods: human stomach cancer may be related to dietary factors.

Marquardt, H.; Rufino, F.; Weisburger, J. H. *Science, USA* 195 (4293) 1000-1001 (1977) [26 ref. En] [Naylor Dana Inst. for Disease Prevention, American Health Foundation, Valhalla, New York 10595, USA]

By the Salmonella typhimurium test, extracts of Japanese raw fish treated in the laboratory with nitrite showed mutagenic activity which is prevented by addition of ascorbate. Extracts from similarly treated beef and hot dogs were nonmutagenic. The data conform to a working concept that the high stomach cancer incidence in Japanese and certain other populations may be due to specific dietary factors of an alkyl nitrosamide type. AS

88

[Reduction of the nitrate content of drinking water by treatment with a condensation resin.]

Experimentelle Untersuchungen und Ergebnisse zur Herabsetzung des Nitratgehaltes von Trinkwasser unter Verwendung eines Kondensationsharzes.

Thielemann, H.

Zeitschrift für die Gesamte Hygiene und ihre Grenzgebiete 23 (2) 99-100 (1977) [2 ref. De, en, ru] [Hygiene-Inst., Martin-Luther-Univ., Halle-Wittenberg, German Democratic Republic]

A procedure is described for reduction of the nitrate content of drinking water by treatment with an anion-exchange resin (a condensation resin prepared from a 2:1 mixture of trimethylolmelamine and dichlorodimethoxysilane).

Treatment of water samples containing 25.0, 75.0 or 105.0 mg nitrate/l. with this resin resulted in reduction of the nitrate concn. by 90.3%, 90.7% and 91.4% respectively. No health hazard as a result of accumulation of Cl^- ions in the water as a result of chloride/nitrate exchange was observed. Chloride concn. > 250 mg/l. imparted a salty flavour to the water. Max. recommended concn. in the water is (mg/l.); $CaCl_2$ 500; or $MgCl_2$ 168; or $NaCl$ 400. IN

89

Nitrate pollution of groundwater from nitrogen fertilizers and animal wastes in the Punjab, India.

Singh, B.; Sekhon, G. S. *Agriculture and Environment* 3 (1) 57-67 (1976) [15 ref. En] [Dep. of Soils, Punjab Agric. Univ., Ludhiana, India]

57 samples of water were obtained from (i) 46 wells situated on cultivated farms and (ii) 11 wells near village settlements in the Ludhiana and Hoshiarpur districts of Punjab in June and Sept. 1975. Water from (ii) is regularly used for drinking. Nitrate content of water from (ii) was significantly higher than (i), ranges being 0.30-60.40 and 0.20-35.0 mg/l. respectively; animal wastes appear to be the main contributor in (ii). Nitrate concn. of well water decreased significantly with depth to water table, but correlated positively with amount of N fertilizers added annually/unit area. AL

90

Elimination of sulphite interference in the spectrophotometric determination of nitrite.

Lew, R. B.

Analyst 102 (1215) 476-479 (1977) [6 ref. En] [Amstar Corp., Spreckels Sugar Div., PO Box 240, Woodland, California 95695, USA]

The amount of nitrite present in diffusion juice could be used as an indicator for the control of thermophilic bacterial infection in the diffuser. A photometric method developed by Shinn [Industrial and Engineering Chemistry, Analytical Edition (1941) 13, 33] was used but the presence of sulphite gave erratic results. The interference of sulphite was eliminated by the use of formaldehyde and changing the order of addition of the reagents. Highly coloured samples, e.g. diffusion juice, thick juice and molasses, are clarified and filtered, and nitrite is determined in the filtrate. To a sample containing 4-30 μg nitrite are added, in order, 2 ml of 5% formaldehyde solution, 0.2% sulphanilamide solution, 2 ml of 6M HCl and, except to the sample blank, 0.2% N-(1-naphthyl)ethylenediamine dihydrochloride. Absorbance at 540 nm is measured after 2 min. As much as 10 mg/l. of sulphite causes no interference when 0.4 mg/l. of nitrite is present, but at sulphite concn. ≥ 20 mg/l. interference is significant. Nitrite recovery was 99-101% when 10-30 μg nitrite was added to samples of factory juice, compared to 31-83% recovery by Shinn's method. AL

91

Possible role of iron(II)-amino acid complexes in nitrite depletion and inhibitor formation in cured meats.

Larkworthy, L. F.; Turnbull, M. H.; Yavari, A. *Chemistry and Industry* No. 10, 401-402 (1977) [20 ref. En] [Dep. of Chem., Univ. of Surrey, Guildford GU2 5XH, UK]

The type of complex formed by Fe(II) with amino acids and their reactions with nitric oxide were investigated. From chemical studies it is concluded that Fe(II)-amino acid complexes can react in several ways with nitric oxide, i.e. produce isolable iron-nitrosyls, be oxidized to Fe(III) species, and, in the case of cysteine, form a disulphide which remains coordinated to the metal nitrosyl. These types of reactions are likely to be important not only in the formation of inhibitory substances but also in the depletion of free nitrite which occurs during the heat treatment and storage of cured meats. AL

92

Nitrite and sulphhydryl groups in the inhibition of *Clostridium botulinum* in meat products.

Lee, S. H.; Cassens, R. G.; Sugiyama, H. *Abstracts of the Annual Meeting of the American Society for Microbiology* 77, 246 (1977) [En] [Univ. of Wisconsin, Madison, Wisconsin, USA]

Ground pork trim (approx. 20% fat) was formulated with 2.5% salt, and 0, 50, 100, 150, 200 or 300 ppm of NaNO₂, canned and heated at 90°C for 1.5 h, 100°C for 2.0 h or 110°C for 2.5 h. Some of the meat was treated with silver lactate to block endogenous sulphhydryl groups before it was mixed with the curing agent. Tests with Ag treated meat showed spores would germinate in it. Meat homogenates were made from all treatment combinations by diluting the meat 1:1 with buffer (pH 6.1), and the level of free nitrite was adjusted to 30 ppm to eliminate the effect of different levels of residual nitrite. Tubes were inoculated with spores of *C. botulinum* 62A and observed for gas production at 30°C. Cans heated at 100°C were stored 8 wk, then also inoculated and observed for swelling at 22°C. An inhibitor due to heating nitrite in the presence of meat was detected in both the canned product and homogenates. Its activity was lower when product was processed at higher temp. and decreased during prolonged storage. Similar results were obtained from Ag treated meat indicating that SH groups are not necessary for formation of the inhibitor. AS

93

Recent nitrosamine analyses in cooked bacon.

Sen, N. P.; Donaldson, B.; Seaman, S.; Collins, B.; Iyengar, J. Y. *Canadian Institute of Food Science and Technology Journal* 10 (1) A13-A15 (1977) [18 ref. En] [Canada Dep. of Health & Welfare, Food Res. Div., Ottawa, Ontario, Canada]

The results of a survey in the Ottawa area in 1975 by the Canadian Health Protection Branch

are reported and show mean contents of 45 ppm NaNO₃ and 62 ppm NaNO₂ in uncooked bacon, and 15 parts/billion N-nitrosopyrrolidine (NPy) in cooked lean and 25 parts/billion NPy in cooked fat. A statistical comparison of this data with that obtained in 3 earlier surveys, again in the Ottawa area only, indicates that levels of total NPy (in µg produced by cooking 1 kg raw bacon) were 12, 24, 29 and 13 in 1975, 1974, 1972 and 1970 respectively. AL

94

Nitrites and nitrosamines in perspective.

Rubin, L. J.

Canadian Institute of Food Science and Technology Journal 10 (1) A11-A13 (1977) [8 ref. En] [Canada Packers Ltd., Toronto, Ontario M6N 1K4, Canada]

The problem of nitrites and nitrosamines in the diet, particularly in cured meat products and bacon, is discussed. But such cured products are not the only source of ingested nitrite, they may contribute only up to one third, the rest being formed from ingested nitrate by microflora in the mouth. The nitrate comes from common leafy vegetables (e.g. spinach, lettuce, beets, radish) and even via drinking water. Nitrosamines are not limited to cured meats, but are also found in urban air, soil, water, and sewage-treatment wastes. The question of toxicology is briefly discussed. AL

95

[Determination of nitrite in meat products.]

Iran, Institute of Standards & Industrial Research of Iran

Iran Standard ISIRI 988, 21pp. (1974) [Pe] [PO Box 2937, Tehran, Iran]

96

[Conference on nitrates and nitrites in human nutrition, Dijon 11 and 12 May, 1976.]

[Conference proceedings]

France, Centre National du Coordination des Etudes et Recherches sur la Nutrition et l'Alimentation

Annales de la Nutrition et de l'Alimentation 30 (5/6) 637-871 (1976) [Fr, en]

Lectures given at this study meeting on the role of nitrates and nitrites in human nutrition were presented under 3 headings: Nitrates and nitrites in the environment; their presence and fate in foods of vegetable origin (pp. 637-705); Nitrates and nitrites as food additives; their presence and fate in foods of animal origin (pp. 707-792); and Metabolism and toxicology (in monogastric animals) (pp. 793-871). 14 relevant papers are abstracted separately, and are given in the FSTA author index under France, Centre National du Coordination des Etudes et Recherches sur la Nutrition et l'Alimentation [Nitrates/Nitrites Symposium]. RM

97

N-nitroso compounds in the environment.
[Conference proceedings]
Bogovski, P.; Walker, E. A.; Davis, W.
International Agency for Research on Cancer;
World Health Organization (Editors)
IARC Scientific Publications No. 9, xv + 243pp.
(1974) [many ref. En] 1211 Geneva 27,
Switzerland; World Health Organization Price
SF50.00 [TARC, Lyon, France]

[Continued from preceding abstr.] Some evidence of the presence of traces of nitrosamines in cider distillates, by P. Bogovski, E. A. Walker, M. Castegnaro & B. Pignatelli (pp. 192-196, 17 ref.); The effect of ascorbate on amine-nitrite hepatotoxicity, by J. J. Kamm, T. Dashman, A. H. Conney & J. J. Burns (pp. 200-204, 13 ref.); Experiments on the degradation of nitrosamines by plants, by J. Sander, M. Ladenstein, J. LaBar & F. Schweinsberg (pp. 205-210, 7 ref.); Investigations on amines in the human environment, by G. B. Neurath & O. Schreiber (pp. 211-214, 13 ref.); Some studies on the production of nitrosamines in the urinary bladder and their subsequent effects, by M. J. Hill & G. Hawsworth (pp. 220-222, 4 ref.); The precursors of N-nitroso compounds in foods, by C. L. Walters, B. E. Newton, D. V. Parke & R. Walker (pp. 223-228, 10 ref.); and Possible relationship between nitrates, nitrosamines and gastric cancer in south-west Colombia, by G. Hawsworth, M. J. Hill, G. Gordillo & C. Cuello (pp. 229-234, 7 ref.). Reports and recommendations (pp. 239-243) are included.
AL

98

[Toxicological evaluation of nitrosamine precursors.] Die gesundheitliche Beurteilung von Nitrosaminbildnern. [Lecture]
Marquardt, P.
Qualitas Plantarum - Plant Foods for Human Nutrition 27 (1) 85-98 (1977) [17 ref. De, en]
[Laufenerstrasse 9, 7800 Freiburg/Brsg., Federal Republic of Germany]

Aspects considered in this discussion of nitrosamines include: structure and carcinogenicity; organ-specificity of carcinogenic activity of nitrosamines; precursors of nitrosamines (nitrates, nitrites, oxides of nitrogen, and primary or secondary amines); factors influencing nitrosamine formation (pH, relative concn. of precursors, presence of catalysts or inhibitors); nitrates in drinking water and foods of vegetable origin; bacterial reduction of nitrate to nitrite; nitrosamines in cured meat products; and problems of establishment of an acceptable daily intake value for nitrosamines. [See FSTA (1977) 9 11A722.]
AJDW

99

[Reduction of nitrate contents in infant foods.]
[Lecture]

Auffray, A.; Paufigue, J.
Annales de la Nutrition et de l'Alimentation 30 (5/6) 701-705 (1976) [Fr, en] [CREALIS, Cent. d'Etudes et de Recherches Alimentaires a Brive, BP88, Zone du Teinchurier, France]

• According to recent French legislation, NO_3^- in infant foods must not exceed 50 mg/kg for babies <4 months old, and while no standard has been fixed for older babies, a tolerance of 300 mg/kg is usual. Amounts found in fresh vegetables are often higher (e.g. 100-1500 in carrots, 50-4000 mg/kg in spinach). Technological treatments to reduce NO_3^- concn. also result in losses of 10-50% of minerals, >50% of ascorbic acid, >35% of thiamine, 10-30% of soluble sugar. Efforts to reduce NO_3^- contents should therefore be directed to agrochemical practices. [See FSTA (1977) 9 11A688.] RM

100

[Conventional and unconventional agriculture. Comparative studies on the quality of the produce.]
Konventioneller und alternativer Landbau - Vergleichende Untersuchungen über die Qualität der Ernteprodukte.

Diehl, J. F.; Wedler, A.

Berichte der Bundesforschungsanstalt für Ernährung No. 1, 143pp. (1977) [many ref. De, en] [Bundesforschungsanstalt für Ernährung, Karlsruhe, Federal Republic of Germany]

This report comprises 2 sections: a literature survey covering studies on effects of agricultural methods on the composition and organoleptic properties of foods published since the 1930's; and a 15-yr experimental study (starting in 1961) conducted at Geisenheim, Federal Republic of Germany, to compare effects of NPK fertilizer and compost on the yield and composition of vegetables. Experimental data are given for concn. (as appropriate) of vitamin C, β -carotene, Cl, P, Ca, Mg, Na, K, chlorophyll, oxalic acid, total acids, solanine, total sugar, NO_3^- , total N, protein and DM in 'Früremona' var. spinach, 'Praeco' var. Savoy cabbage, 'Magdeburger Markt' var. celeriac and 'Saskia' var. potatoes. The results show little effect of mineral vs. organic fertilizer on the composition of the vegetables, except that mineral fertilizers tended to give spinach with a higher nitrate concn. than that grown using compost.
AJDW

101

Nitrate in drinking water: health hazard unlikely.
Wild, A.

Nature, UK 268 197-198 (1977) [15 ref. En]
[Dep. of Soil Sci., Univ. of Reading, Reading, Berks, UK]

Some information on the concn. of nitrate in river water in the UK and the relative contribution from various sources is discussed. The author

comments that there is no evidence to support the WHO limits for safe concn. of nitrate in drinking water (<11.3 mg/l. is recommended, 11.3-22.6 mg/l. is 'acceptable', and >22.6 mg/l. is unacceptable), and that it should be recognised that 22.6 mg/l. is without risk to adults, although it seems advisable to keep an upper limit of 11.3 mg/l. for young infants until evidence indicates otherwise. AL

102

[Presence of nitrates in pome and stone fruits.] [Lecture]

Huguët, C.; Bonafous, M.; Ducailar, G.

Annales de la Nutrition et de l'Alimentation 30 (5/6) 673-682 (1976) [30 ref. Fr, en] [Dep. d'Agron., INRA, 84 000 Montfavet, France]

Ionometric detn. indicated that NO_3^- accumulation did not reach very high levels in pears, apples, cherries and peaches. Slight variations in nitrate nitrogen of fruits from experimental plots were observed in relation to the uptake by the trees of N, Mg and Ca, the maturity of the fruits, var., and application of a growth retardant. The concn. of nitrate nitrogen reported for several var. of the fruits ranged from 0.4 to 9.5 mg/l. of fruit juice, showing that the products are well suited for human consumption. [See FSTA (1977) 9 11A688.] RM

103

[Nitrate accumulation by some market-garden produce.] [Lecture]

Blanc, D.

Annales de la Nutrition et de l'Alimentation 30 (5/6) 667-672 (1976) [3 ref. Fr, en] [INRA, Sta. d'Agron. et Physiol. Vegetale, 45 Boulevard du Cap, 06602 Antibes BP 78, France]

Experiments on NO_3^- accumulation in vegetables in relation to the NO_3^- supply were done on lettuces, tomatoes and aubergines. Tabulated results obtained in soilless culture showed that NO_3^- accumulation in different vegetables was affected by its distribution in the different parts of the plant: more NO_3^- accumulated in tomato leaves than in roots, and more in roots than in fruits. Increasing NO_3^- supply between 2 and 14 m-equiv./l. of culture solution significantly increased its concn. in lettuce leaves (from 72 to 967 ppm in fresh leaves) and in aubergines (from 55 to 303 ppm fresh wt.), but had no effect on its concn. in tomato fruits. NO_3^- accumulation was also dependent on the equilibrium between the different ions in the nutrient solution, e.g. it was depressed by increasing K^+ or SO_4^{2-} concn. [See FSTA (1977) 9 11A688.] RM

104

[Variations in nitrate content of some boiled vegetables. Simultaneous variations in other nutrients.] [Lecture]

Astier-Dumas, M.

Annales de la Nutrition et de l'Alimentation 30

(5/6) 683-688 (1976) [8 ref. Fr, en] [Cent. de Recherches Foch, 4 Avenue de l'Observatoire 75006, Paris, France]

The results of some brief studies on the effects of boiling vegetables in water are reported: NO_3^- concn. of artichokes, cauliflowers and French beans were reduced by about 50% (e.g. from 3.8 to 1.3, from 64 to 29 and from 231 to 133 mg/kg, respectively). In 9 samples of carrots NO_3^- concn. varied from 166 mg/kg in raw carrots to 229 mg/kg after scraping and washing, and 25-29 mg/kg after 35 min boiling. About 40% of the NO_3^- was found in the cooking water. NO_3^- concn. in frozen spinach fell from 1290 to 168 ppm after 10 min boiling (or to 13%), and in fresh spinach to 17-32% of the value in blanched leaves. Ascorbic acid in spinach was as sensitive to boiling as NO_3^- , falling to 12 or 0-25% respectively in the frozen and fresh blanched product, while Mg concn. fell more slowly (to 60 or 60-62%); and Fe was more resistant to water extraction, falling to 82 or 18-100%, respectively. The results suggest that boiling is a good method to eliminate contaminants. [See FSTA (1977) 9 11A688.] RM

105

[Effect of nitrates in the processing of canned spinach; possible accidents and precautions.] [Lecture]

Wolff, R.

Annales de la Nutrition et de l'Alimentation 30 (5/6) 695-699 (1976) [15 ref. Fr, en] [Inst. Appert, 44 Rue d'Alesia, 75014 Paris, France]

Following studies of failures in the canning of chopped spinach due to high concn. of NO_3^- , the following recommendations are made: use of raw material with relatively low NO_3^- concn., i.e. from spring rather than autumn pickings; complete removal of leaf stalks (which contain 2-3 times as much NO_3^- as blades); blanching at 100°C; and storage at 2°C prior to processing. [See FSTA (1977) 9 11A688.] RM

106

[Nitrates in canned spinach. Effects of technological treatments.] [Lecture]

Sohier, Y.; Poumarat, A.-M.; Berges, P.

Annales de la Nutrition et de l'Alimentation 30 (5/6) 689-694 (1976) [Fr, en] [Lab. Cooperatif., 16 Rue Maignan-Lariviere, 95390 Saint-Prix, France]

During the last 20 yr the NO_3^- content of spinach increased regularly with increasing use of fertilizers. At the same time the yield of canned spinach was noticeably reduced, from 65 to 54 kg canned/100 kg fresh spinach. Cannery trials made to reduce the NO_3^- levels (preheating, blanching, renewing the blanching water) led to a loss of about 45% NO_3^- on DM between the raw and canned product, but about the same NO_3^- levels/kg in raw and processed (pureed) spinach from the same batch (fresh wt. basis). [See FSTA (1977) 9 11A688.] RM

107

[Use of nitrates in cheesemaking.] [Lecture]

Devoyod, J.-J.

Annales de la Nutrition et de l'Alimentation 30 (5/6) 789-792 (1976) [6 ref. Fr, en] [Lab. de Recherches Fromageres, INRA, 15000 Aurillac, France]

In the production of semi-hard cheese, nitrate is added to the milk (e.g. 5-20 g/100 l. for Edam or Gouda) to prevent the late-blowing effect caused by the growth of butyric *Clostridia*. Under normal technological conditions this presents no risk to the consumer, but if the whey is used as a food ingredient, its NO_3^- and NO_2^- concn. must be controlled. [See FSTA (1977) 9 11A688.] RM

108

[Studies on 'Bresaola' manufactured in Valtellina.]

Cantoni, C.; Calcinardi, C.; Schiavello, A.; Longoni, A.

Industria Alimentari 16 (5) 101-104 (1977) [18 ref. It, en] [Istituto di Ispezione degli Alimenti di Origine Anim., Fac. de Med. Vet., Univ. degli Studi di Milano, Milan, Italy]

Manufacture of 'Bresaola', a cured, smoked dried beef product, is briefly described. 30 commercial samples of Bresaola were analysed; tables of results are given. Mean values and ranges for various characteristics were: moisture 56.36 and 43.4-63.0%; protein 30.60 and 22-37.3%; fat 6.03 and 3.8-11.4%; ash 5.90 and 5.3-6.65%; NaCl 4.17 and 2.8-6.0%; total P_2O_5 662.3 and 383-902 [mg/kg?]; NO_2^- 44.5 and 21.3-68.0 mg/kg; NO_3^- 149.7 and 26.6-345.3 mg/kg; and water activity 0.90 and 0.89-0.92. The results show that some samples had NO_3^- concn. above the legal limit. Some samples had relatively high moisture contents, suggesting excessively short drying times. AJDW

109

[Nitrates and nitrites used for treatment of meat products: technical and microbiological aspects.] [Lecture]

Bousset, J.; Fournaud, J.

Annales de la Nutrition et de l'Alimentation 30 (5/6) 707-714 (1976) [many ref. Fr, en] [Lab. de Recherche sur la Viande, INRA-CNRZ, 78350 Jouy-en-Josas, France]

This report is a partial review of recent literature on the role of NO_3^- and NO_2^- in cured meat, including the role of NO_2^- in nitrosamine formation, in formation of the characteristic cured meat colour (promoted by addition of ascorbic acid) and flavour, and for inhibition of microflora, especially *Staphylococci* and *Clostridium botulinum*. Although lower NO_2^- concn. are adequate for developing colour and flavour, there is a risk of microbial food poisoning at NO_2^- concn. < 150 ppm, which is the min. recommended dose.

[See FSTA (1977) 9 11A688.] RM

110

[Nitrates and nitrites in some commercial meat products.] [Lecture]

Custot, F.; Louis, H.; Lapeyrie, R.

Annales de la Nutrition et de l'Alimentation 30 (5/6) 751-757 (1976) [5 ref. Fr, en] [Lab. Cooperatif, 16 Rue Maignan Lariviere, 95390 Saint-Prix, France]

Following an earlier study in 1974 on NO_3^- and NO_2^- contents of 105 samples of cooked hams [Bulletin d'information du Laboratoire cooperatif (1974) No. 97, 1-17], another 166 samples of various meat products were examined in 1975 and 1976. Whilst in the earlier study 15 samples contained > 150 mg NO_2^- /kg (including 10 > 200, 5 > 400 and 1 at 575 mg/kg), in the present study 8 samples contained > 150 NO_2^- mg/kg and 23 contained excess NO_3^- (> 1500 or > 500 mg/kg, depending on the product). Of 56 hams, 2 contained excess NO_2^- and 1 excess NO_3^- . Most of the excess concn. were found in sausage meat: of 58 samples, 4 contained > 150 mg NO_2^- /kg and 17 > 500 mg NO_3^- /kg. 7 of 21 samples of pate contained > 500 mg NO_3^- /kg, but none contained excess NO_2^- absorbed is too close to the recommended acceptable daily intake to provide an adequate safety margin. [See FSTA (1977) 9 11A688.] RM

111

[Nitrite fixation by muscle proteins.] [Lecture]

Rougie, P.; Valin, C.; Goutefongea, R.

Annales de la Nutrition et de l'Alimentation 30 (5/6) 759-765 (1976) [many ref. Fr, en] [Sta. de Recherche sur la Viande, INRA, Theix, 63110 Beaumont, France]

The toxicity of NO_2^- and especially of nitrosamines is reviewed in relation to the presence of free or bound NO_2^- in meat products. The binding of NO_2^- in cured meats is discussed, together with methods of analysis. [See FSTA (1977) 9 11A688.] RM

112

[State of nitrite in meat products.] [Lecture]

Frouin, A.; Thenot, M.; Jondeau, D.; Barraud, C.; Grimault, M.-L.; Durand, P.; Vendeuvre, J. L. *Annales de la Nutrition et de l'Alimentation* 30 (5/6) 773-788 (1976) [42 ref. Fr, en] [Soc. Olida-Caby, 50 Rue de Raspail, 92300 Levallois-Perret, France]

The fate of NO_2^- in cured meat products was investigated. Analysis of many samples of ham and dry sausages by a variety of methods provided no evidence for its oxidation to NO_3^- . Theoretical calculations based on the physico-chemical conditions prevailing in cured meat products suggested a total breakdown of NO_2^- to NO , which can be bound by many of the meat components. Results of the calculations were confirmed by partial vacuum distillation (under 5 cm Hg pressure), absorption spectra in alkaline sulphite

medium [see FSTA (1974) 6 7S890] and the modified Zambelli reaction. All the technological and toxicological effects attributed to NO_2^- are thus explained in terms of more or less strongly bound NO, depending on the medium. Accordingly, nitrosamine would be formed either at very high NO_2^- addition or at high temp., and the risk of its formation can be further reduced by addition of NO-binding compounds, e.g. ascorbic acid. [See FSTA (1977) 9 11A688.] RM

113

[Nitrite and nitrate residues in French cooked hams and shoulders.] [Lecture]

Durand, P.; Venduvre, J.-L.; Hamelin, M. *Annales de la Nutrition et de l'Alimentation* 30 (5/6) 743-750 (1976) [2 ref. Fr, en] [Lab. du Cent. Tech. de la Salaison de la Charcuterie et des Conserves de Viandes, 7 Avenue du General de Gaulle, 94700 Maisons-Alfort, France]

Analysis of 1468 cooked hams and shoulders of 5 quality grades revealed mean NO_2^- contents of 61 mg/kg (90.5% of all samples containing < 150 mg/kg), and mean NO_3^- contents of 292 mg/kg (81.5% of samples containing < 500 mg/kg). There were no significant differences between the quality grades, and no correlations between NO_3^- and NO_2^- contents of individual samples. The products with residual NaNO_3 concn. < 1000 mg/kg were generally manufactured without NO_2^- curing salt, with high level salting and short brining at low temp., which prevented reduction of NO_3^- to NO_2^- . [See FSTA (1977) 9 11A688.] RM

114

The fate of sodium nitrite in bacon.

Woolford, G.; Cassens, R. G.

Journal of Food Science 42 (3) 586-589, 596 (1977) [31 ref. En] [Muscle Biol. Lab., Univ. of Wisconsin, Madison, Wisconsin 53706, USA]

Pork bellies, cured with [^{15}N]- NaNO_2 with and without the addition of sodium ascorbate were used. The depletion of nitrite, originally at 156 ppm, was followed during the processing operation. During the storage of the ^{15}N -labelled, sliced, vacuum packaged bacon further depletion of nitrite in both the lean and adipose tissue portions were seen, the lower nitrite levels being found in the bacon to which ascorbate had been added. The formation and depletion of nitrate was also noted. Analysis of the protein and lipid portions showed incorporation of ^{15}N into both. MS showed that between 73 and 87% of the added ^{15}N remained in the bacon lean portion. The adipose portion contained much less ^{15}N , equivalent to 20-25% of that added. A hot water extract of both lean and adipose fractions showed the presence of ^{15}N greater than the ^{15}N due to nitrite and nitrate. One effect of the addition of ascorbate was to force ^{15}N into water soluble compounds. Examination of connective tissue protein isolated from the adipose tissue portion showed incorporation of ^{15}N , equivalent to 6 ppm NaNO_2 in bacon without

ascorbate vs. 2.5 ppm for bacon with added ascorbate. ^{15}N also showed incorporation of approx. 25% of the added nitrite into the muscle proteins of both bacons, and incorporation of 10% of the added nitrite into the lipid fraction of the adipose tissue. IFT

115

[Nitrates and nitrites as food additives. French and foreign regulations.] [Lecture]

Rochize, S.

Annales de la Nutrition et de l'Alimentation 30 (5/6) 715-742 (1976) [Fr, en] [Service de la Repression des Fraudes et du Controle de la Qualite, 42 bis Rue de Bourgogne, 75007 Paris, France]

Regulations on the use of NO_3^- and NO_2^- in France and the main industrial countries are discussed. In France they may only be used in cured or canned meat and meat products, and residues must be < 150 mg/kg as NaNO_2 and must be mentioned on the labels of prepacked foods. The same basic rules apply in most other countries; only well-defined foods may be treated with specified levels of the salts, and residues are limited to 200-2000 mg/kg NaNO_3 and 70-200 mg/kg NaNO_2 in meat products, 100 mg/kg NaNO_3 and 10 mg/kg NaNO_2 in cheese. Labelling is generally not required. Details of regulations are shown in tables by countries, products, max. permitted levels used and max. residues. The development of harmonized rules and reduction of residual levels in ready-to-eat foods is recommended. [See FSTA (1977) 9 11A688.] RM

116

Intake of nitrate and nitrite of some Swedish consumers as measured by the duplicate portion technique. (In 'Proceedings of the Second International Symposium on Nitrite in Meat Products' [see FSTA (1977) 9 12S2047].) [Lecture]

Jägerstad, M.; Nilsson, R.

pp. 283-287 (1977) [En] [Res. Dep. 2, E-Block, Hospital of Lund, Lund, Sweden]

The duplicate-portion technique was used to estimate the intake of nitrate and nitrite from food by 10 men and 10 women in an agricultural district in southern Sweden. The average daily intake of nitrate was for men 65.9 mg (35-111 mg) and for women 69.7 mg (49-109 mg). The average daily intake of nitrite was for men 4.6 mg (0.9-11.0 mg) and for women 6.6 mg (4.7-9.0 mg). The values, with one exception, were well under the max. acceptable daily intake (5 mg/kg bodyweight for nitrate and 0.2 mg for nitrite) recommended by FAO/WHO. If the amount of nitrite produced in saliva is also taken into account, most of the values for nitrite intake exceed the recommended value. AS

117

Polyamines in green and roasted coffee.

Amorim, H. V.; Basso, L. C.; Crocomo, O. J.; Teixeira, A. A.

Journal of Agricultural and Food Chemistry 25 (4) 957-958 (1977) [16 ref. En] [Dep. of Chem.-Biochem, Escola Superior de Agric 'Luiz de Queiroz', Sao Paulo, Brazil]

3 polyamines, putrescine (1,4-diaminobutane), spermine (α,δ -bis(γ -aminopropylamino)butane), and spermidine (α -(γ -aminopropylamino)- δ -aminobutane), were isolated from green coffee beans and identified by TLC. During the roasting process these polyamines are degraded, probably being precursors of coffee flavour formation. However, coffee beans of the same var. and harvested in the same yr, which produced different beverage quality, showed similar polyamine content. No nitrite was detected in the green bean, which would avoid nitrosamine formation during the roasting process. AS

118

[Determination of nitrite in imported meat and meat products.]

Iwaida, M.; Kaneda, Y.; Nishikawa, M.

Bulletin of the National Institute of Hygienic Sciences [Eisei Shikenjo Hokoku] 94, 122-124 (1976) [2 ref. Ja, en]

Analysis of imported meat products for nitrite during the period Nov. 1974-Sept. 1975 were carried out according to the Draft International Standard ISO/DIS 2918.2 ISO/TC 34. 10.3 ppm (< limit of restriction) nitrite was found in Danish pork luncheon meat, with 8 other product samples being almost free from residual nitrite. The ISO draft method was found to be highly reproducible. [From En summ.] JRR

119

Collaborative study of modified AOAC method of analysis for nitrite in meat products.

Fiddler, R. N.

Journal of the Association of Official Analytical Chemists 60 (3) 594-599 (1977) [8 ref. En] [E. Regional Res. Cent., USDA, Philadelphia, Pennsylvania 19118, USA]

A modified version of the AOAC method of analysis for nitrite in meat and meat products was tested collaboratively by 23 laboratories. Results were compared with those obtained by the official AOAC method. Recommended modifications include: substitution of N-(1-naphthyl)ethylenediamine and sulphanilamide for Griess reagent, separate addition and 1:10 dilution of the above reagents, 20 min colour development and absorbance read at 540 nm, substitution of NaNO_2 for AgNO_2 and NaCl , omission of HgCh , screening of filter paper for nitrite contamination, and more precise dilution of sample aliquot. The standard curve is then linear up to 10 $\mu\text{g N}/50\text{ ml}$. Results were statistically treated by Youden's technique for comparing 2 methods, using a

matched pair sample scheme. The random error for the modified method was significantly lower than the random error for the official method. A t-test showed no difference in bias between the 2 methods. AS

120

[Possible ways of reducing quantities of nitrite and nitrate added to meat products.] Möglichkeiten zur Verringerung des Zusatzes von Nitrit und Nitrat bei Fleischerzeugnissen. [Review]

Mirna, A.; Coretti, K.

Fleischwirtschaft 57 (6) 1121-1124 (1977) [17 ref. De, en, fr] [Bundesanstalt für Fleischforschung, 8650 Kulmbach, Federal Republic of Germany]

This review discusses the effects of composition and processing conditions on the residual NO_2^- and NO_3^- concn. in meat products. Additives with reducing properties or able to lower the pH (e.g. ascorbic acid) decrease NO_2^- but increase NO_3^- concn. Compounds with activated methylene groups, e.g. sorbic acid, can react with NO_2^- forming very strong bacteria-inhibiting compounds (possibly nitrolic or ethyl nitrolic acid) allowing the production of bacteriologically stable meat products with very low NO_2^- addition. Before these methods can be permitted, the NO_2^- reaction products must be thoroughly tested for possible health hazards. RM

121

Nitrates and nitrites: reinterpretation of analytical data by means of bound nitrous oxide. (In

'Proceedings of the Second International Symposium on Nitrite in Meat Products' [see FSTA (1977) 9 12S2047].) [Lecture]

Frouin, A.

pp. 115-120 (1977) [En] [Res. Dep. of the Olida-Caby Cie, 50 Rue Raspail, 92304, Levallois-Perret, France]

Discrepancies in detn. of nitrate and nitrite in cured meat products by various methods (including French Standard methods NF-V4409 and 4410) are discussed, with special reference to the state of added nitrite in meat products. Theoretical considerations and further analyses suggest that the 'nitrite' present in cured meats is reduced to NO ; this is then bound to proteins, thiols, carbonyl compounds, etc. in the meat. There is, therefore, a complex equilibrium between the various NO -binding constituents; analytical reagents upset this equilibrium, thereby releasing variable amounts of NO . This hypothesis of formation and binding of NO is discussed in relation to nitrosamine formation in cured meats. AJDW

122

Experiences with nitrite and nitrate ban in Norway.

(In 'Proceedings of the Second International Symposium on Nitrite in Meat Products' [see FSTA (1977) 9 12S2047].) [Lecture]

Hoyem, T.

pp. 293-297 (1977) [En] [Norwegian Food Res. Inst., PO Box 50, 1432 As, Norway]

Experience with restrictions on nitrates and nitrites in meat products in Norway (which came into force on 1 Jan., 1973) is discussed, with reference to: changes in the restrictions during the period 1973-1976; effects on the appearance of meat products; the current max. limit of 5 mg 'natural residual nitrite'/kg meat product; health aspects; experiences of the food inspection services; methods used by manufacturers to produce a desirable red coloration of their products without the use of nitrite; consumer responses and opinions; and the responses of the meat processing industry. AJDW

123

Chemical behaviour of nitrite in meat products. I. The stability of proteinbound nitrite during storage.

(In 'Proceedings of the Second International Symposium on Nitrite in Meat Products' [see FSTA (1977) 9 12S2047].) [Lecture]

Olsman, W. J.

pp. 101-109 (1977) [En] [Cent. Inst. for Nutr. & Food Res. TNO, Utrechtseweg 48, Zeist, Netherlands]

In model meat products of pH 5.35-5.8, more than half the free nitrite lost during the first few days of storage was recovered as protein-bound nitrite. Bound nitrite increased to a max. and then gradually declined during storage with kinetics similar to those for the depletion of free nitrite. However, the activation energy for decomposition of bound nitrite was significantly higher than that for disappearance of free nitrite, and was practically independent of pH. [See following abstr. for part II.] AS

124

Chemical behaviour of nitrite in meat products. II. Effect of iron and ethylenediaminetetraacetate on the stability of protein-bound nitrite.

(In 'Proceedings of the Second International Symposium on Nitrite in Meat Products' [see FSTA (1977) 9 12S2047].) [Lecture]

Olsman, W. J.

pp. 111-114 (1977) [En] [Cent. Inst. for Nutr. & Food Res. TNO, Utrechtseweg 48, Zeist, Netherlands]

Addition of Fe^{2+} at 0.1 or 1 mmol kg^{-1} increased contents of protein-bound nitrite in the stored product, whereas EDTA had the opposite effect. These effects were more pronounced at pH 6.2 than at 5.65, and were completely absent at pH 5.1. [See preceding abstr. for part I.] AS

125

Fate of nitrite in meat. (In 'Proceedings of the Second International Symposium on Nitrite in Meat Products' [see FSTA (1977) 9 12S2047].) [Lecture]

Cassens, R. G.; Woolford, G.; Lee, S. H.; Goutefongea, R.

pp. 95-100 (1977) [En] [Univ. of Wisconsin, Madison, Wisconsin, USA]

Studies on the fate of added nitrite in cured meat products are summarized. At equal muscle pH, 'white' muscles tended to have higher residual muscle pH than 'red' muscles; this is probably due to reaction of nitrite with myoglobin in the red muscles. Heated myoglobin bound approx. twice as much nitrite as non-heated myoglobin, suggesting that both the free coordination positions of Fe are occupied by NO in the presence of nitrite in heated samples. A substantial proportion of added nitrite reacts with non-haem proteins; it is suggested that a relatively low proportion is bound to sulphhydryl groups. Certain amino acids are nitrosated; nitrite also reacts with amide linkages. Approx. 10% of added nitrite reacts with adipose tissue, mainly with the connective tissue and unsaturated lipids. Reaction pathways of nitrite in bacon were also studied; ascorbate was found to promote depletion of nitrite. Overall results for various meat products showed the following proportions of added ^{15}N -labelled nitrite recovered in various fractions: as nitrite 5-20%, as nitrate 1-10%, as gases 1-5%, sulphhydryl-bound 5-15%, lipid-bound 1-5% and protein-bound 20-30%. Total labelled N recovery was 38-100%, generally 70-80%. AJDW

126

Irradiation as a conceivable way of reducing nitrites and nitrates in cured meats. (In 'Proceedings of the Second International Symposium on Nitrite in Meat Products' [see FSTA (1977) 9 12S2047].) [Lecture]

Wierbicki, E.; Heiligman, F.; Wasserman, A. E.

pp. 75-81 (1977) [En] [Food Eng. Lab., US Army Natick R&D Command, Natick, Massachusetts, USA]

Studies on the potential use of irradiation to minimize the quantity of nitrite used in cured meats (ham, corned beef, bacon) are described. Data are given for the composition and organoleptic properties of samples cured conventionally, and for irradiated products cured at low nitrite concn. The results show that, in irradiated samples, added nitrite concn. can be reduced to the level required for formation of 'cured' flavour and colour (approx. 25 mg/kg). Small quantities of nitrate are also required, to prevent fading of the cured colour, to supplement the nitrite, and to scavenge electrons formed during irradiation. Total added nitrate + nitrite should be 75 mg/kg (of which 33-50% should be nitrite) in irradiated ham or corned beef, and 50 mg/kg (of which 50% should be nitrite) in bacon. No nitrosamines were detected in irradiated/low nitrite cured ham or pre-fried bacon; low concn. of nitrosopyrrolidine were, however, detected in fried samples of non-precooked irradiated/low nitrite cured bacon. AJDW

127

Inhibitory effect of some Perigo-type compounds on clostridium spores in pasteurized meat products. (In 'Proceedings of the Second International Symposium on Nitrite in Meat Products' [see FSTA

(1977) 9 12S2047].) [Lecture]

Roon, P. S. van; Olsman, W. J.

pp. 53-61 (1977) [En] [Fac. of Vet. Med., Univ. of Utrecht, Biltstraat 172, Utrecht, Netherlands]

Studies were conducted on inhibition of clostridia by NaNO_2 and cysteyle nitric oxide ferrate (CNOF) in pasteurized meat products. Incubation trials showed that CNOF was a poorer inhibitor of clostridial growth than nitrite. Storage at 8°C for ≤ 6 months considerably reduced the content of total nitrite in samples containing NaNO_2 . In samples containing CNOF, almost all the nitrite was present in the protein-bound form; total nitrite concn. varied little during storage. In a second study, cans of inoculated beef (with added NaNO_2 or $\text{NaNO}_2 + \text{Fe}^{2+}$) were held for 0-4 wk at 3°C immediately after pasteurization; they were then incubated at 30°C , and subsequently tested for swelling and clostridial growth. Delay before swelling increased with increasing time of holding at 3°C before incubation; this effect was greater for samples at pH 5.9 than for those at pH 6.2. The increased inhibitory activity seemed to be related to increased protein-bound nitrite concn.; however, addition of Fe^{2+} increased protein-bound nitrite concn. but reduced inhibitory activity. Further studies were conducted on inhibition of clostridia by NaNO_2 or S-nitrocysteine in canned chopped ham; inhibitory activities of the 2 additives were similar. S-nitrocysteine was found to be labile in the brine added to the ham during chopping. AJDW

128

Inhibitory effect of nitrite reaction products and of degradation products of food additives. (In 'Proceedings of the Second International Symposium on Nitrite in Meat Products' [see FSTA (1977) 9 12S2047].) [Lecture]

Mirna, A.; Coretti, K.

pp. 39-45 (1977) [En] [Fed. Inst. for Meat Res., 865 Kulmbach, Blaich, Federal Republic of Germany]

Studies were conducted on inhibitory effects of nitrite reaction products, condensation and degradation products of ascorbic acid and carbohydrates, and condensation products of cysteine with aldehydes and carbohydrates; test organisms used were *Enterobacter liquefaciens*, *Escherichia coli*, *Staphylococcus aureus*, and a *Micrococcus* strain isolated from a starter culture. The trials were conducted in liquid culture media. Reaction of nitrite with carbonyl compounds containing an activated methylene group may result in formation of nitrolic acids. Of these, ethylnitrolic acid is inhibitory at a concn. of 10 mg/kg, whereas propylnitrolic acid is inhibitory only at 100 mg/kg. *Micrococcus* sp. and *Staph. aureus* were inhibited by 5-hydroxymethylfurfural (5-HMF) at a concn. of 500 mg/kg; *E. liquefaciens* was inhibited by 5-HMF at 2000 mg/kg; and *E. coli* was not inhibited by 5-HMF. Several other compounds showed low inhibitory activity against ≥ 1 of the test organisms; these included 3,4-dihydroxyphenylalanine, 2,5-anhydro-D-mannose, 4-butyrolactone, γ -crotonolactone, 2-furoic acid and furoin. AJDW

129

Effect of nitrite on the development of *Staphylococcus aureus* in fermented sausages. (In 'Proceedings of the Second International Symposium on Nitrite in Meat Products' [see FSTA (1977) 9 12S2047].) [Lecture]

Labots, H.

pp. 21-27 (1977) [En] [Cent. Inst. for Nutr. & Food Res. TNO, Utrechtseweg 48, Zeist, Netherlands]

Effects of added nitrite (0, 30, 60 or 120 mg/kg), glucose (0 or 7 mg/kg) and nitrate (quantity not specified) on growth of *Staphylococcus aureus* in Dutch brine-ripened or air-ripened dry sausages were studied. The sausages were inoculated with *Staph. aureus* at a count of approx. $10^3/\text{g}$ before ripening. The sausages were ripened in brine for 2 days, then dried for a further 3 days, or ripened in air or N_2 for 3 days followed by drying for 4 days. Graphs of results are given. With brine-ripened sausages, added nitrite inhibited growth of *Staph. aureus*, the extent of inhibition increasing with increasing nitrite concn. Nitrite had little effect on growth of *Staph. aureus* in the surface layers of air-ripened sausages; nitrite effectively controlled *Staph. aureus* in sausages ripened in N_2 . Rapid pH decrease (e.g. attributable to added glucose) is not necessary for control of *Staph. aureus*, provided that sufficient nitrite is added. AJDW

130

Influence of energy and protein supplements on grazing and feedlot performance of steers. Denham, A. H.

Journal of Animal Science 45 (1) 1-7 (1977) [10 ref. En] [Dep. of Anim. Sci., Colorado State Univ., Fort Collins, Colorado 80523, USA]

2 trials were conducted to evaluate the effects of (i) feeding different levels of energy supplementation during the spring grazing season and protein supplementation in autumn, and (ii) supplementing energy during the whole summer grazing period, as well as the effect of supplements on subsequent feedlot performance of steers. Feedlot and carcass data are tabulated for steers previously supplemented with 4 levels of protein, and for 3 steer breeds supplemented with 0 or 0.91 kg corn/day. AL

131

Thermal destruction of microorganisms in meat by microwave and conventional cooking.

Crespo, F. L.; Ockerman, H. W.

Journal of Food Protection 40 (7) 442-444 (1977) [10 ref. En] [Ohio State Univ., Columbus, Ohio 43210, USA]

When heating ground beef to internal temp. of 34° , 61° , and 75°C , high temp. ($232 \pm 6^\circ\text{C}$) oven cooking was more effective for bacterial destruction than low temp. ($149 \pm 6^\circ\text{C}$) oven cooking. Low temp. oven cooking was more effective than microwave cooking. These differences in microbial destruction rates became significant ($P < 0.05$) when the meat reached the 75°C internal temp. level. AS

132

Processing and sensory evaluation of a primal cut cured with nitrite alone or nitrite-nitrate mixture.

(In 'Proceedings of the Second International Symposium on Nitrite in Meat Products' [see FSTA (1977) 9 12S2047].) [Lecture]

Wasserman, A. E.; Fiddler, R. N.
pp. 67-72 (1977) [En] [USDA, Philadelphia, Pennsylvania 19118, USA]

Comparative studies were conducted on curing of beef sirloin tips in (i) normal-type brines containing 7750 mg $\text{NaNO}_3/\text{l.}$ + 1670 mg $\text{NaNO}_2/\text{l.}$, or (ii) experimental brines containing 2200 mg $\text{NaNO}_2/\text{l.}$ The meat was cured for 6 wk, then dried at 65°C for approx. 3 days. The meat was analysed for NaCl , NaNO_3 , NaNO_2 and nitrosamines; microbiological quality of the meat and the curing brine was evaluated, and the meat was evaluated organoleptically. Curing brine composition had little effect on the microflora or NaCl content of the beef. Nitrite and nitrate concn. in the cured dried products were, respectively (mg/kg): (i) 37 and 3097; and (ii) 26 and 103. No nitrosamines were detected in samples cured with (i); dimethylnitrosamine was detected (at a concn. of $< 14 \mu\text{g/kg}$) in samples cured with (ii). Taste panel trials showed the product cured in (i) to be preferred; both products were, however, well accepted if served as chipped beef in white sauce. AJDW

133

N-nitroso compounds in products widely consumed in France: hams. (In 'Proceedings of the Second International Symposium on Nitrite in Meat Products' [see FSTA (1977) 9 12S2047].) [Lecture]

Klein, D.; Poullain, B.; Debry, G.
pp. 289-292 (1977) [En] [Dep. de Nutr. de des Maladies Metaboliques, Univ. de Nancy I, INSERM U 59, 40 Rue Lionnois, 54000 Nancy, France]

9 samples of ham of various types (cooked, smoked, Bayonne, Westphalian, Parma) were studied. Values for residual NaNO_2 contents ranged from 4 to 13 mg/kg; NaNO_3 contents ranged from 50 to 363 mg/kg. All 9 samples contained dimethylnitrosamine; concn. observed were ($\mu\text{g/kg}$): < 1 in 3 samples, 2.0, 2.46, 3.2, 4.2, 9, and 18.4. Presence of dimethylnitrosamine in the sample containing $18.4 \mu\text{g/kg}$ was confirmed by MS, the other samples were not tested by MS. No relation between concn. of nitrates, nitrites and nitrosamines was observed. These results are discussed in relation to literature data. AJDW

134

Nitrite and nitrate in the control of Clostridium botulinum in cured meats. (In 'Proceedings of the Second International Symposium on Nitrite in Meat Products' [see FSTA (1977) 9 12S2047].) [Lecture]

Roberts, T. A.; Ingram, M.
pp. 29-38 (1977) [En] [Meat Res. Inst.,

Langford, Bristol BS18 7DY, UK]

Studies showed *Clostridium botulinum* to be present (at a count of approx. 2 cells/kg) in pork in the UK. Growth of *Cl. botulinum* in collar bacon and gammon was markedly greater than growth in the lean or fat of back bacon. Addition of 500 mg NaNO_3/kg had little effect on growth of *Cl. botulinum* in bacon. *Clostridia* multiplied in only approx. 5% of samples at $\text{pH} < 6.0$, but in about 40% of those at $\text{pH} > 6.2$. Nitrite appeared to slightly retard spoilage of vacuum-packaged high-pH bacon. Studies on effects of added nitrite, nitrate, ascorbate, polyphosphate and incubation temp. on growth of *Cl. botulinum* in pasteurized cured pork slurry are described. Growth and toxin formation tended to increase with increasing incubation temp.; nitrite reduced (but did not fully prevent) growth of *Cl. botulinum*. Ascorbate and polyphosphate never reduced (but sometimes stimulated) growth. Effects of nitrate were dependent on temp. and other additives present. Relatively intense heat treatment (e.g. holding the core temp. at 70°C for 1 h) reduced the incidence of botulinum toxin-positive samples. In general, nitrite concn. decreased during storage; some nitrite formation from added nitrate was, however, observed. AJDW

135

Carcinogenicity study on rats fed on canned heated nitrite-treated meat: preliminary communication.

(In 'Proceedings of the Second International Symposium on Nitrite in Meat Products' [see FSTA (1977) 9 12S2047].) [Lecture]

Olsen, P.; Meyer, O.
pp. 275-278 (1977) [En] [Inst. of Toxicology, Nat. Food Inst., DK 2860 Soborg, Denmark]

A total of 626 rats was used in a 132 wk, 2-generation feeding trial conducted to evaluate the carcinogenicity of canned chopped pork containing 0-4000 mg nitrite/kg. A control group of rats received a diet based on casein. Data for the incidence of benign and malignant tumours show no significant effect of the nitrite content of the diet on the incidence of either benign or malignant tumours. Dimethylnitrosamine was present in the canned meat containing 4000 mg nitrite/kg, but not in samples containing lower levels of nitrite. AJDW

136

Role of nitrite and ascorbate in the microbiological safety of vacuum-packed sliced bacon. (In 'Proceedings of the Second International Symposium on Nitrite in Meat Products' [see FSTA (1977) 9 12S2047].) [Lecture]

Crowther, J. S.; Holbrook, R.; Baird-Parker, A. C.; Austin, B. L.
pp. 13-20 (1977) [En] [Unilever Res., Sharnbrook, Bedford, UK]

Studies on effects of NaCl , nitrate, nitrite and ascorbate concn. on growth and toxin formation by *Clostridium botulinum* and *Staphylococcus aureus*

inoculated into vacuum-packaged bacon are described. Bacon samples studied contained 4 or 5.5% NaCl, 0, 1000 or 2000 mg ascorbate/kg, 0, 100 or 200 mg nitrite/kg, and 0 or 250 mg nitrate/kg. Packs for studies on *Cl. botulinum* were held at 25° or 30° C for ≤ 28 days; open and sealed packs for studies on *Staph. aureus* were held at 15° or 25° C for ≤ 28 days. Tables of results are given. Mildly-salted bacon (4% NaCl) readily supported botulinum toxin formation in the absence of nitrate or nitrite; addition of 100 mg/kg nitrite + 250 mg/kg nitrate reduced botulinum toxin formation, and 200 mg nitrite/kg gave increased protection against botulinum toxin formation. Bacon containing 5.5% NaCl did not readily support toxin formation; however, treatment effects showed similar trends to those observed in the mildly-salted bacon. At both NaCl concn., toxin formation was greater at 30° than at 25° C. Sodium ascorbate did not adversely influence the activity of nitrite against *Cl. botulinum*; addition of 1000 or 2000 mg ascorbate/kg enhanced the activity of nitrite added at 100 mg/kg. Omission of nitrite and nitrate increased the risk of toxin formation by factors of 20 for medium-salted and 440 for mildly-salted bacon. Growth and toxin formation by *Staph. aureus* were not significantly affected by nitrate, nitrite or ascorbate; however, vacuum-packaging prevented enterotoxin formation. AJDW

137

Consumer evaluation of the flavour of bacon cured with and without sodium nitrite. (In 'Proceedings of the Second International Symposium on Nitrite in Meat Products' [see FSTA (1977) 9 12S2047].) [Lecture]

Wasserman, A. E.; Kimoto, W.
pp. 73-74 (1977) [En] [USDA, Philadelphia, Pennsylvania 19118, USA]

Comparative taste trials were conducted with bacon cured in brines (i) without nitrite, or (ii) containing 120 mg nitrite/l. The flavour of fried (i) and (ii) bacon samples was evaluated by a total of 969 consumers; of these, results for only 704 were usable. Little or no difference in acceptability of (i) and (ii) bacons was observed, although the 2 types of bacon differed in colour. Age, sex and frequency of consumption of bacon by the consumers were not clearly related to the results. AJDW

138

N-nitrosopyrrolidine in bacon obtained from 10 commercial bacon production plants. (In 'Proceedings of the Second International Symposium on Nitrite in Meat Products' [see FSTA (1977) 9 12S2047].) [Lecture]

Birdsall, J. J.
pp. 211-213 (1977) [En] [American Meat Inst., Washington, DC 20007, USA]

Practical trials at 10 commercial bacon factories in the USA are described. Batches of bacon were prepared containing: no NaNO₂, erythorbate or

ascorbate; or 40, 80 or 120 mg NaNO₂/kg together with 550 mg erythorbate or ascorbate/kg. After refrigerated storage for 3 wk, raw samples were analysed for residual nitrite, nitrate and erythorbate; cooked samples were analysed for nitrosopyrrolidine. Of 154 samples studied, only 25 contained presumptive nitrosopyrrolidine by GLC analysis; only 10 were confirmed by MS (1 made with 40 mg nitrite/kg, 4 made with 80 mg/kg and 5 made with 120 mg/kg). The highest nitrosopyrrolidine concn. recorded was 9 mg/kg. Reducing the added NaNO₂ concn. from 120 to 80 mg/kg did not markedly appear to reduce the occurrence of low levels (≤ 10 µg/kg) of nitrosopyrrolidine. AJDW

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FAB 48

NITRATES AND NITRITES IN MEAT PRODUCTS

SELECTED FROM VOLUME **10**

FOOD SCIENCE AND TECHNOLOGY ABSTRACTS

under the direction of

Commonwealth Agricultural Bureaux, Farnham Royal, Bucks; Gesellschaft für Information und Dokumentation, Frankfurt am Main; Institute of Food Technologists, Chicago; Centrum voor Landbouwpublikaties en Landbouwdocumentatie (Pudoc), Wageningen.

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H. BROOKES
ASSISTANT EDITOR

1

Microdetermination of nitrate by gas chromatography-mass spectrometry technique with multiple ion detector.

Tan, Y. L.

Journal of Chromatography 140 (1) 41-46 (1977) [7 ref. En] [Health & Safety Lab., HSC, US Energy Res. & Development Administration, 376 Hudson Street, New York, New York 10014, USA]

The principle of this method is the nitration of 1,3,5-trimethoxybenzene in sulphuric acid. In this medium nitration is followed by the hydrolysis of the ether groups, yielding a simple nitrobenzene as the final product. This is then analysed by gas chromatography-MS and detected with a multiple ion detector (MID). Hexamethylbenzene (HMB) serves as an internal standard, and the interference of nitrite and chloride is prevented by using sulphamic acid and mercuric sulphate respectively. This method allows detn. of microquantities of nitrate in environmental samples. Due to irregularities of results the MID was tested with HMB and pure nitrobenzene in benzene. Linear response was observed down to MID readings of 0, 0.1, 0.2, 0.4 and 0.6 at a gain of 100, thus excluding possible instrumental irregularities. Contamination during sample preparation was responsible for irregular results and it is concluded that the method, performed under a cleaner environment, should yield better accuracy. Analysis of a few μg nitrate/l. may be possible. Results are given graphically. The method is suitable for detn. of nitrate in water, including drinking water. SP

2

Mesophilic lactobacilli as a cause of nitrate reduction in Gouda cheese.

Nieuwenhof, F. F. J.

Netherlands Milk and Dairy Journal 31 (3) 153-162 (1977) [11 ref. En] [Netherlands Inst. for Dairy Res. (NIZO), Ede, Netherlands]

Gouda cheeses were made from pasteurized (72°C for 10 s) milk supplemented with 25 ml saturated CaCl_2 solution, 22 ml rennet and 20 g KNO_3 /100 l. milk and using 1% BD starter Ur. 18 strains of *Lactobacillus casei* (isolated from cheese) and 1 of *L. coryniformis* subsp. *coryniformis* 33 were examined for their ability to reduce nitrate during cheese ripening. The strains were added individually or in mixtures to the cheese milk. *L. coryniformis* and 2 strains of *L. casei* were able to reduce all added nitrate within 6 wk. The nitrate reducing ability of these strains was also demonstrated using freeze-dried sterile cheese as a medium. The presence of nitrate-reducing lactobacilli as a cause of butyric acid fermentation in cheese is discussed. MEG

3

The assay of protein-bound nitrite in meat products.

Olsman, W. J.; Leeuwen, C. M. van

Zeitschrift für Lebensmittel-Untersuchung und -Forschung 164 (4) 239-242 (1977) [18 ref. En,

de] [Cent. Inst. for Nutr. & Food Res., TNO, Zeist, Netherlands]

The method described is an improvement of that of Mirna [see Proceedings of the European Meeting of Meat Research Workers (1970) No. 16, C16, p. 681]. Approx. 5 g sample is homogenized in 45 ml 86% (v/v) aqueous acetone, and the homogenate centrifuged for 2 min at 2000 rev/min (80 ml centrifuge tube). The supernatant may be used for detn. of free or haem-bound nitrite. The pellet is extracted with 45 ml 80% (v/v) aqueous acetone, recentrifuged, and suspended in 5 ml 0.2M phosphate buffer, pH 7.0. The suspension is transferred to a 100-ml beaker and water added to approx. 50 ml. 2.5 ml 5% HgCl_2 solution are added dropwise with stirring, and then the beaker is heated on a boiling water bath for 30 min with occasional stirring. After cooling to room temp. 5 ml saturated sodium tetraborate solution are added, the beaker contents are transferred to a 100-ml volumetric flask, 1 ml 30% ZnSO_4 solution is added and the vol. made up with water. The solution is filtered through nitrite-free paper and the nitrite content of the filtrate determined with Griess reagent, measuring the absorption at 520 nm against a reagent blank. This method gives significantly higher results than the previous method, and a significantly lower relative SD (2.0 vs. 3.5%; $P < 0.01$). DIH

4

Nitrates and nitrites in poultry products.

United States of America, Food & Drug Administration

Federal Register 42 (171, Sept. 2) 44376-44381 (1977) [En] [Washington DC, USA]

A review is given of the history of use, safety, and legal status of nitrates and nitrites in poultry products. CAS

5

[Determination of nitrites in wort during fermentation.]

Cejka, P.

Kvasny Prumysl 23 (5) 102-104 (1977) [8 ref. Cs, ru, en, de] [Vyzkumny Ustav Pivovarsky a Sladarsky, Prague, Czechoslovakia]

A new, simple and reliable method is proposed for photometric detn. of nitrites in beer and wort, involving diazotization of sulphanilic acid in the presence of acetic acid, and coupling with α -naphthylamine. A reddish-violet colour is formed, which is specific and reproducible; extinction is measured at 525 nm against a blank test. HgCl_2 is recommended for stabilization of the test sample. The effect on the stability of the nitrites of the temp. and pH of the beer and wort is discussed, and existing methods for detn. of nitrite are outlined. STI

6

Proceedings of the meat industry research

conference, March 25-26, University of Chicago, USA. [Conference proceedings]

United States of America, American Meat Science

Association; United States of America, American Meat Institute Foundation

Proceedings of the Meat Industry Research Conference 150pp. (1976) [many ref. En]

The full text is given of papers presented at this conference, including: Regulatory aspects and their effect on the meat food industry, by H. C. Mussman (pp. 17-22); Relative risk of nitrate and nitrite ingestion, by S. R. Tannenbaum (pp. 25-33, 37 ref.); Nitrates and nitrites as components of the normal environment, by T. H. Jukes (pp. 41-48, 11 ref.); and Nitrosamine carcinogenesis and latency, by H. B. Jones & A. Grendon (pp. 49-53, 5 ref.). Another 6 papers are abstracted separately, and appear in the author index under United States of America, American Meat Science Association [1976 Symposium]. JRR

7

[Presence of nitrate and nitrite in horse meat, and oxidation of nitrite to nitrate in canned meats.]

Cantoni, C.; Bianchi, M. A.

Archivio Veterinario Italiano 28 (1/2) 47-48 (1977) [9 ref. It, en] [Istituto di Ispezione degli Alimenti di Origine Anim., Univ. degli Studi di Milano, Milan, Italy]

Nitrate and nitrite were determined in 5 samples each of frozen horse meat from (i) Brazil, (ii) Argentina and (iii) Uruguay; 5 samples of (iv) fresh Italian horse meat were also tested. Nitrite concn. determined were (mg/100 kg): (i) 89-153; (ii) 153-160; (iii) 14.6-22; and (iv) 20-29. Trials were conducted to evaluate oxidation of added nitrite to nitrate in canned meat. Samples of canned meat (with 100 mg added nitrite/100 g) were sterilized at 120°C for 4 h; nitrite and nitrate concn. in the canned product were, resp., 20-26 and 30-37 mg/100 g. AJDW

8

Influence of sodium erythorbate on color development, flavor and overall acceptability of frankfurters cured with reduced levels of sodium nitrite.

Sebranek, J. G.; Schroder, B. G.; Rust, R. E.; Topel, D. G.

Journal of Food Science 42 (4) 1120-1121 (1977) [20 ref. En] [Dep. of Anim. Sci., Iowa State Univ., Ames, Iowa 50011, USA]

Frankfurters were cured with various levels of sodium nitrite (0, 26, 52 and 156 p.p.m.) and sodium erythorbate (0 and 546 p.p.m.) and evaluated by a consumer taste panel. Colour, flavour and overall acceptability decreased with decreasing nitrite concn. Flavour and acceptability of frankfurters were increased by the use of erythorbate but only at low (< 52 p.p.m.) concn. of sodium nitrite. IFT

9

Variation in inhibition of *C. botulinum* by nitrite in perishable canned comminuted cured meat.

Tompkin, R. B.; Christiansen, L. N.; Shaparis, A. B.

Journal of Food Science 42 (4) 1046-1048 (1977) [6 ref. En] [Swift & Co., Res. & Development Cent., Oak Brook, Illinois 60521, USA]

A series of 7 tests was conducted to establish a base line for the inhibition of clostridium botulinum by nitrite in a perishable canned meat product (comminuted cured pork). The product was subjected to abusive storage at 27°C. The degree of variation in swell times and rates among the tests was determined. Predicted average times to first swell were 6.7, 29.8, 82.6 and 94.3 days when 0, 50, 100 and 156 µg NaNO₂/g were added to the meat. The primary effect of nitrite appears to have been in determining the length of the lag phase. Once swelling commenced, the rate at which the cans swelled was not significantly different at 50, 100, and 156 µg NaNO₂/g. This information will be used to evaluate additives for controlling botulinal growth and toxin production under the conditions described. IFT

10

A comparison of proline and putrescine as precursors of N-nitrosopyrrolidine in nitrite-treated pork systems.

Gray, J. I.; Collins, M. E.

Journal of Food Science 42 (4) 1034-1037 (1977) [24 ref. En] [Dep. of Food Sci., Univ. of Guelph, Guelph, Ontario N1G 2WL, Canada]

The role of proline and putrescine as precursors of N-nitrosopyrrolidine was investigated in model and pork systems containing 150 and 1000 p.p.m. sodium nitrite. Both compounds increased the levels of N-nitrosopyrrolidine formed. However, it was concluded from the concn. (30-1000 p.p.m.) of proline and putrescine used in the study that the former was the more likely precursor of N-nitrosopyrrolidine in bacon. The distillate (condensate) collected on heating nitrite-treated pork samples in a heating flask was examined for its N-nitrosopyrrolidine content. Approx. 27-49% of the total N-nitrosopyrrolidine produced was volatilized during the cooking process. IFT

11

[Presence of nitrates in haricot bean (*Phaseolus vulgaris* L.) and their distribution within the plant under various conditions of nitrogen fertilization.]

Decau, J.; Bouniols, A.; Pace, A.; Mondies, M.; Pujol, B.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, D 281 (10) 631-634 (1975) [5 ref. Fr] [INRA, Sta. d'Agronomie de Toulouse, BP 12, 31320 Castanet-Tolosan, France]

Whilst nitrogen fertilization improves the yield of market garden crops, the possibility of excessive nitrate-nitrite concn. in portions used for human consumption must be considered. Haricot bean (var. dwarf Coco) was cultivated in soil fertilized with 0, 60, 120 and 180 kg N/ha (as (NH₄)₂SO₄). Data are presented on: total N absorbed by the plant, wt. yield of pods and beans, N X 6.25% of pods and beans, nitrate contents of roots, stems, leaves, pods, beans, nitrate reductase activity and

physiological variations (flowering, fruiting, maturity). Nitrate content was highest in the roots (point of absorption) and decreased during transfer via stems to the flowering organs, with parallel increase of total N due to protein synthesis. The green pods and beans (for human consumption) contained no nitrate. Warning is given of possible variations with other var. — ELC —

12

Domiat cheese from pasteurized milk. IV. Gassiness inhibition.

El-Koussy, L. A.; Tawab, G. A.; Hofi, A. A.; El-Sokkary, A. M.

Agricultural Research Review 53 (7) 157-162 (1975) [10 ref. En] [Anim. Production Res. Inst., Agric. Res. Cent., Min. of Agric., Cairo, Egypt]

Domiat cheese was prepared from milk flash pasteurized at 85°C and salted at (i) 7%, (ii) 10% or (iii) 15%. All treatments received 0.25% lactic starter. Cheeses were pickled in cans containing drained whey from the respective batches. Cheese from (i) was also pickled in whey with an additional (iv) 2% or (v) 4% salt by wt. Cheese (vi) was made as for (i) but with added KNO₃ at 2 mg/100 kg milk.

Cheeses were stored for 3 months at 25-30° or 15-16°C. A high quality cheese resulted from treatment (v). A better organoleptic score but slightly reduced yield resulted from storage at a higher temp. Cheeses from (ii) and (iii) gave good quality and reasonable yield when stored at 25-30°C but cool storage resulted in a deterioration in quality. Nitrate addition inhibited gassiness, but produced cheese with a sour, metallic flavour. [See preceding abstr. for part III.] JRR

13

[Effect of pH on nitrate reduction by some psychrotrophic bacteria.]

Warminska-Radyko, I.; Knaut, T.; Tysnicka, B. *Zeszyty Naukowe Akademii Rolniczo-Technicznej w Olsztynie* No. 164 (Technologia Żywności 10) 59-67 (1976) [9 ref. Pl, ru, en] [Inst. Inżynierii i Biotech. Żywności, ART, Olsztyn, Poland]

The ability to reduce nitrate added at 250 mg NO₃⁻/l. to broth and reconstituted dried milk was studied using 6 strains of *Pseudomonas* and 3 of *Micrococcus* isolated from milk held for 3 days at <10°C. The microorganisms were added to the media at approx. 50 cells/ml, and incubation was at 22°C for ≤66 h in the pH range 5-8. Max. reduction occurred with both species at pH of approx. 6.4 in milk and 6.7 in broth. Nitrites appeared only transiently, indicating further transformation of reduction products. SKK

14

[Mineral and urea contents of bulk mixed milk and milk from individual producers.]

Mahieu, H.; Luquet, F. M.; Mouillet, L. *Lait* 56 (599/560) 657-698; 57 (561/562) 55-112 (1976; 1977) [Fr] [ITEB, 149 Rue de Bercy, 75579 Paris Cedex 12, France]

For this extensive 3-yr study, France was divided into 9 regions on the basis of geographical criteria and predominant breeds of cows. Samples of milk from individual producers were tested in 1973, and bulk mixed milk was tested in 1974/1975. Results are presented in numerous tables and discussed. Mean values or ranges for 1973 and 1974/1975 resp. were: nitrates, 0.35 and 0.38-0.77 mg/l.; urea, 230 and 186-285 mg/l.; Fe, 1019-1030 and 345-653 µg/l.; Cu, 122-145 and 166-224 µg/l.; Mn, 45-47 and 55-67 µg/l.; Zn, 2.68-2.81 and 3.78-4.37 mg/l.; F, 13-14 and 12-21 µg/l.; and As, 27-32 and 9-59 µg/l. The following elements were determined during 1974/1975 only: Ca, 1184-1231 mg/l.; P, 878-965 mg/l.; Na, 429-488 mg/l.; and Mg, 104-114 mg/l. Hg was rarely found, Pb was never found, and mean Cd level was about 35 µg/l. CDP

15

[Mineral and urea contents of bulk mixed milk and milk from individual producers.]

Mahieu, H.; Luquet, F. M.; Mouillet, L. *Alimentation et la Vie* 65 (2) 183-250 (1977) [8 ref. Fr] [ITEB, 149 Rue de Bercy, 75579 Paris Cedex 12, France]

See preceding abstr.

16

Nitration of benzene as method for determining nitrites and nitrates in meat and meat products.

Wu, W. S.; Saschenbrecker, P. W.

Journal of the Association of Official Analytical Chemists 60 (5) 1137-1141 (1977) [21 ref. En] [Guelph Regional Lab., Agric. Canada, 620 Gordon Street, Guelph, Ontario N1G 1Y4, Canada]

Nitrites and nitrates in meat and meat products (beef liver, bologna, minced beef and corned beef) are determined by nitration of benzene in the presence of sulphuric acid. Nitrites are converted to nitrates by permanganate oxidation prior to nitration. The heat of dilution originating from the sulphuric acid is sufficient to complete the reaction. The final product, nitrobenzene, is determined by GLC and electron capture detection. Peak height quantitation is both accurate and reproducible. Recoveries are tabulated for samples spiked at 4, 20 and 200 p.p.m. NO₂⁻. Interferences from impurities are rarely encountered, and may be differentiated easily. The method also has potential application to samples other than meat. Min. detectable amounts of NO₂⁻ and NO₃⁻ were 0.04 and 0.05 p.p.m., resp. AS

17

[Meat preserves. Smoked pasteurized bacon in slices.]

Union of Soviet Socialist Republics. Gosudarstvennyi Komitet Standartov *Soviet Standard GOST 9167-76*, 3pp. (1976) [Ru]

This standard applies to salted and smoked bacon slices from the belly of carcass halves, canned and pasteurized. The product shall contain 2.5-3.5% salt, ≤ 100 mg sodium nitrite/100 g, ≤ 100 mg Sn salts (in terms of Sn)/kg, and no Pb salts or foreign admixtures. The standard also covers packaging, transport (refrigerated vehicles at 0-5°C) and storage ($\leq 75\%$ RH at 0-5°C; shelf life is 6 months). HBr

18

Nitrates and nitrites in meat products. Statement of policy, request for data.

United States of America, Department of Agriculture

Federal Register 42 (201, Oct. 18) 55626-55627 (1977) [En] [Washington, DC, USA]

Nitrates and nitrites as currently used in the manufacture of cured meat products have the potential of interacting with components of the meat to form carcinogenic nitrosamines. Data are requested to demonstrate that the use of nitrates and/or nitrites in the production of bacon does not result in the formation of carcinogenic nitrosamines during processing and/or preparation. Data shall be based on a cooking time of ≥ 3 min on each side and at a temp. of $\geq 340^\circ$. The finding of carcinogenic nitrosamine is not considered positive until confirmed by mass spectrometry. CAS

19

Effect of sodium nitrite on the destruction of thiamine.

Kaya, K.

Agricultural and Biological Chemistry 41 (10) 2055-2058 (1977) [8 ref. En] [Dep. of Chem., Toyama Inst. of Health, Ohtemachi, Toyama, Japan]

When sodium nitrite-containing thiamin solution was heated at 75°C for 60 min, elemental S and 4-methyl-5-(β -hydroxyethyl) thiazole were identified, and thiochrome was possibly produced. When sodium nitrite-free thiamine solution was heated at 75°C for 60 min, 4-methyl-5-(β -hydroxyethyl) thiazole was a main product, and elemental S and thiochrome were not produced. AS

20

Nitrates and nitrites in foods.

Plain, J. M.

Food and Nutrition Notes and Reviews 34 (2) 49-54 (1977) [13 ref. En] [Commonwealth Dep. of Health, Canberra, Australia]

Nitrates and nitrites in foods are discussed under the following headings: fate of nitrate and nitrite in humans; hazards to health of ingestion of nitrates and nitrites; presence of nitrates and nitrites in foods and water; standards for nitrate and nitrite levels in foods and drinking water; and infant feeding. SP

21

[Nitrates and nitrites in Irpinia wines.]

Coppola, V.

Rivista di Viticoltura e di Enologia 30 (6) 248-257 (1977) [14 ref. It, fr, en] [Scuola di Viticoltura e di Enologia, Conegliano, Treviso, Italy]

Tabulated data on composition of 32 white and 60 red wines from the Irpinia district in Campania, Italy (1972-1975 harvests), 90% of them from small producers and 40% with controlled denomination of origin, include the following mean values with ranges in parentheses: ash, white wines 2.02 (1.46-2.90), and red wines 2.49 (1.94-3.20) g/l.; nitrates as N_2O_5 , white wines 1.65 (0.42-4.82), and red wines 2.42 (0.85-5.20) mg/l.; nitrites as N_2O_3 , white wines 30 (3-78), and red wines 59 (3-92) $\mu\text{g/l.}$; and total N, white wines 167 (96-256), and red wines 205 (118-292) mg/l. SKK

22

Influence of fertilizer, irrigation, and storage treatments on nitrate-N content of potato tubers.

Augustin, J.; McDole, R. E.; Painter, G. C.

American Potato Journal 54 (4) 125-136 (1977) [8 ref. En, es] [Dep. of Food Sci., Food Res. Cent., Univ. of Idaho, Moscow 83843, USA]

A survey was undertaken to investigate the nitrate-nitrogen ($\text{NO}_3\text{-N}$) content of potatoes grown on different soil types with different fertilizer and irrigation treatments. Tuber $\text{NO}_3\text{-N}$ contents were determined immediately after harvest and after periods of storage of ≤ 210 days. $\text{NO}_3\text{-N}$ in tubers (dry wt. basis) ranged from low values of 82-122 p.p.m. for low N fertility levels to a max. of 192-285 p.p.m. at the highest N rates, where irrigation was applied at optimum levels. The average $\text{NO}_3\text{-N}$ in tubers under such conditions was 150-160 p.p.m. Where irrigation management was less than optimum, the $\text{NO}_3\text{-N}$ content of tubers increased, reaching an average max. value of 786 p.p.m. at the highest fertilizer rate. The study showed that the $\text{NO}_3\text{-N}$ level in tubers increased with N fertilization rates, although there was not a linear relationship between N fertilizer rate and tuber $\text{NO}_3\text{-N}$. The highest $\text{NO}_3\text{-N}$ levels obtained in the tubers under proper irrigation management, even with 800 lb N/acre, did not exceed 300 p.p.m. $\text{NO}_3\text{-N}$ and were usually < 200 -p.p.m. Data collected from this study suggest that improper irrigation, especially with high N fertilizer rates, results in a dramatic increase in $\text{NO}_3\text{-N}$ level in the tubers. Some individual tubers contained > 1200 p.p.m. $\text{NO}_3\text{-N}$. There was an apparent slight increase in $\text{NO}_3\text{-N}$ in the tubers with storage, although this increase was not consistent. AS

23

[The nitrate content of spinach.] Zum Nitratgehalt in Spinat.

Schütt, I.

Lebensmittel-Industrie 24 (7) 318-320 (1977) [8

ref. De, en, ru] [Bezirks-Hygiene-Inspektion & Inst., Schwerin, German Democratic Republic]

Problems with excessive nitrate concn. in spinach for industrial processing are discussed, with special reference to spinach for manufacture of baby foods. Tables of data are given for nitrate concn. in samples of raw spinach and spinach-based baby foods from various locations in the German Democratic Republic during the period 1972-1976. Factors responsible for high nitrate concn. are briefly considered, with special reference to N fertilization, the preceding crop on the site where the spinach is grown, and differences between spring and autumn spinach. IN

24

[The nitrate and nitrosamine problem with foods of plant origin.] Das Nitrat-Nitrosamin-Problem bei pflanzlichen Nahrungsmitteln. [Review] Schwerdtfeger, E.

Qualitas Plantarum - Plant Foods for Human Nutrition 27 (3/4) 339-348 (1977) [many ref. De, en] [Bundesforschungsanstalt für Ernährung, Aussenstelle D-6222 Geisenheim/Rheingau, Federal Republic of Germany]

Aspects considered in this review include: analytical methods for nitrosamines; nitrate and nitrite contents of foods of vegetable origin; effects of var., fertilizers, etc. on nitrate and nitrite concn.; formation of nitrosamines by reaction of nitrites with amines; microbial synthesis of nitrosamines; and inhibitory effects of ascorbic acid on nitrosamine formation. AJDW

25

[Nitrite, *Clostridium botulinum* and nitrosamines.] Zinck, O.

Dansk Veterinaertidsskrift 60 (8) 347-350 (1977) [Da] [Karensgade 6, Copenhagen Vb, Denmark]

The use of nitrite in meat products is discussed, largely on the basis of a study tour in the USA. Aspects considered include: use of nitrite for control of *Clostridium botulinum* (with reference to the distribution of *Cl. botulinum*, frequency of its spores in foods, incidence of botulism and infant botulism, and detection of *Cl. botulinum* and its toxin); permitted concn. of nitrite in meat products in the USA; distribution of nitrite in cured meats; effects of nitrites on the organoleptic properties of meat products; the possibility of formation of carcinogenic nitrosamines; effects of ascorbic acid on nitrosamine formation; and analytical methods for detn. of nitrosamines. AJDW

26

Control of nitrosamine formation in nitrite cured meat by use of aromatic primary amines.

Bharucha, K. R.; Rubin, L. J.; Cross, C. K. (Canada Packers Ltd.)

United States Patent 4 039 690 (1977) [En]

The formation of nitrosamines in cooked, cured meat products is reduced or eliminated by using aromatic primary amines, e.g. *p*-alkoxyaminobenzenes, in the curing mixture or to treat the cured meat, e.g. bacon. GL

27

Curing procedures for smoked chicken.

Stubblefield, J. D.; Hale, K. K., Jr.

Poultry Science 56 (4) 1135-1139 (1977) [16 ref.

En] [Dep. of Poultry Sci., Univ. of Georgia, Athens, Georgia 30602, USA]

Subjective analysis of smoked chickens indicated that inclusion of NaNO_3 in the cure solution for 18-24 h cure times produced no increase in colour and decreased cured flavour and saltiness scores. Smoked chickens cured for 24 h have higher cured flavour scores, cured yields and cooked yields than those cured for 18 h. In one experiment, cooked yields of 69% were attained for endpoint meat temp. of 80°C, while in another experiment cooked yields of 81% were reached with endpoint meat temp. of 77°C. Equilibration for 24 h produced higher salt content (3.2%) in cooked meat when compared to 4 h equilibration (2.7%). Initiation of curing by immersion of carcasses into brine in frozen state gave cooked meat salt levels of 2.7% while carcasses cured from fresh or thawed states had salt levels of 3.3%. AS

28

Consumer acceptance of nitrite-free bacon.

Wasserman, A. E.; Kimoto, W.; Phillips, J. G.

Journal of Food Protection 40 (10) 683-685 (1977) [9 ref. En] [E. Regional Res. Cent., Philadelphia, Pennsylvania 19118, USA]

Consumer response to bacon cured with and without nitrite was determined. Bacon slices were scored individually on a 7-point hedonic scale for 'like-dislike' responses and consumers indicated preference between the 2 treatments. Questionnaires from 704 respondents were analysed for sex, age and frequency of consumption of bacon. Bacon was 'liked moderately' (5.9-6.1 on the hedonic scale) whether cured with or without nitrite. There were no significant differences as a result of sex, age or frequency of use. Each bacon was preferred by half of the population tested; there was no significant difference between treatments. An acceptable bacon can be prepared by curing without nitrite; this study did not consider shelf stability or the anticlostridial effect of nitrite. AS

29

Determination of nitrite ion using differential pulse polarography.

Chang, S.-K.; Kozeniauskas, R.; Harrington, G. W.

Analytical Chemistry 49 (14) 2272-2275 (1977)

[30 ref. En] [Dep. of Chem., Temple Univ., Philadelphia, Pennsylvania 19122, USA]

Nitrite ion can be determined with a high degree of accuracy and sensitivity by differential pulse polarography utilizing the rapid and quantitative reaction between nitrite ion and diphenylamine at low pH with thiocyanate ion as catalyst. The calculated detection limit was shown to be 0.3 (as NO_2^-) parts/billion in simple aqueous solution. The method was used to determine nitrite in processed meats and human saliva. The results for processed

meat are compared to those obtained by the AOAC method; agreement was excellent. AS

30

On the aetiology of gastric cancer: mutagenicity of food extracts after incubation with nitrite. Marquardt, H.; Rufino, F.; Weisburger, J. H. *Food and Cosmetics Toxicology* 15 (2) 97-100 (1977) [17 ref. En] [Naylor Dana Inst. for Disease Prevention, Valhalla, New York 10595, USA]

Treatment of certain foods, such as fish, beans and borsch which are typical of areas with a high incidence of gastric cancer, with 5000 p.p.m. nitrite resulted in the formation of one or more mutagenic principles, as indicated by a Salmonella typhimurium test. S. typhimurium strain TA 1535 was the most sensitive of several indicator organisms tested. Formation of mutagenic material was highest at pH 3 with 5000 p.p.m. nitrite, but significant amounts were also produced with 1000 p.p.m. nitrite. More acidic as well as alkaline media led to a loss of the mutagenic activity over a 24-h period. Ascorbic acid prevented the formation of the mutagenic material in nitrite-treated fish. Nitrite treatment of hot dogs, pork, beef, barley and sour milk produced no detectable mutagenic material. AS

31

Feeding tests in rats on mixtures of nitrite with secondary and tertiary amines of environmental importance.

Lijinsky, W.; Taylor, H. W.

Food and Cosmetics Toxicology 15 (4) 269-274 (1977) [25 ref. En] [Biol. Div., Oak Ridge Nat. Lab., Oak Ridge, Tennessee, USA]

The possible formation of N-nitroso compounds in vivo from ingested secondary or tertiary amines and nitrite was tested with 13 amino compounds selected on the basis of their widespread availability to man. The amino compounds were administered to rats in the drinking water with or without sodium nitrite. Survival rates differed little between the various groups, and only a few of the amines, either alone or in combination with nitrite, induced a significant incidence of malignant tumours. The results provide further evidence that ingestion of secondary and tertiary amines together with nitrite can lead to the formation of significant amounts of carcinogenic N-nitroso compounds in the stomach. AS

32

Nitrate, nitrite, dimethylnitrosamine and N-nitrosopyrrolidine in some Chinese food products. Fong, Y. Y.; Chan, W. C.

Food and Cosmetics Toxicology 15 (2) 143-145 (1977) [16 ref. En] [Dep. of Biochem., Univ. of Hong]

Over 60 samples of commonly consumed Chinese food products, including dried shrimps,

shrimp sauce and paste, oyster sauce, fish sauce, Chinese sausages and dried squid, were analysed for the presence of dimethylnitrosamine and N-nitrosopyrrolidine. Low levels of dimethylnitrosamine (1-15 parts/billion) and N-nitrosopyrrolidine (2-37 parts/billion) were detected in such foods, and were confirmed in several samples by GC-MS. No correlation was found between the amounts of residual nitrate or nitrite present and the levels of nitrosamines found in the food. AS

33

Nitrosamines and their precursors in some Estonian foodstuffs. [Lecture]

Kann, J.; Tauts, O.; Raja, K.; Kalve, R.

IARC Scientific Publications No. 14, 385-394 (1976) [9 ref. En] [Dep. of Food Tech., Polytech. Inst., Tallinn, Estonian SSR, USSR]

Contents of N-nitroso compounds, nitrites and secondary amines in some Estonian foods were determined, and results are presented. Nitrosamine levels were highest in canned smoked fish samples, and generally considerably higher in smoked fish products than other fish products. Nitrosamine content in meat products was much lower than in fish products. Of the meat product samples analysed only smoked meat contained > 10 µg nitrosodimethylamine/kg. Relatively high nitrite concn. were detected in smoked fish and meat products. A relatively high nitrate content was found in vegetables. A correlation between the contents of nitrosamines (1-13 µg/kg) and of nitrites (1.5-13.0 mg%) in sausage products was noted. Smoking increased the nitrite and nitrate ion contents as well as the nitrosamine content in foods, probably due to presence of nitrous gases in wood smoke, which depends on the construction of the smoke generator. Nitrosamine content of meat products can be reduced by addition of ascorbic acid. [See FSTA (1978) 10 5C147.] AL

34

[Nitrates in drinking water in the city of and countryside around Rome.]

Nurzia, N.; Spadoni, S.; Massi, C.

Rassegna Chimica 29 (3) 187-190 (1977) [It, en] [Lab. di Chimica, Ufficio d'Igiene e Sanita del Comune di Roma, Rome, Italy]

The water of 300 wells near Rome and some drinking fountains in the city was analysed for nitrate. Results (tabulated) showed 12 wells (4.7%) with > 45 mg/l. (max. 160 mg/l.) and only 5 out of 55 Roman fountains with 10 mg/l. nitrate. RM

35

[Bacteriological aspects of keeping freshly prepared spinach hot. I. Change in bacterial count with temperature.] Bakteriologische Aspekte des Warmhaltens von frisch zubereitetem Spinat. I. Veränderung der Keimzahl in Abhängigkeit von der Temperatur.

Bomar, M. T.; Wedler, A.; Hajek, M. Z.

Archiv für Lebensmittelhygiene 27 (6) 226-229 (1976) [45 ref. De] [Bundesforschungsanstalt für Ernährung D-75 Karlsruhe, Federal Republic of Germany]

Frozen spinach was cooked in the usual way and kept up to 10 h at 20, 30, 60 and 70°C. Total mesophiles and thermophiles were counted at 0, 2, 5 and 10 h. Tabulated results showed that cooking produced selective activation of thermophilic bacteria. The surviving 10^1 - 10^2 bacteria/g increased at 20°C to a max. of 8×10^3 /g after 5 h and 4.5×10^5 after 10 h, at 30°C to 2×10^5 after 5 h and 2×10^8 after 10 h, at 60°C to 2×10^7 after 5 h and 5×10^7 after 10 h, at 70°C to 5×10^4 after 5 h and 6×10^4 after 10 h. No growth was observed at 80°C. Results suggest that bacteriological safety requires the cooked product to be kept at $>70^\circ\text{C}$. Analyses of NO_3^- and NO_2^- contents of the spinach suggest that changes in concn. depend on the numbers and types of microorganisms, and the holding time and temp. RM

36

[Nitrate and nitrite residues in cheeses.]

Chirkina, T. F.

Gigiena i Sanitariya No. 4, 111-112 (1976) [9 ref. Ru] [Vostochno-Sibirskii Tekh. Inst., Ulan-Ude, USSR]

Various types of cheese made in the Buryat and Altai regions of the USSR (Steppe, Kostroma, Dutch-type, Sovetskii, Lithuanian) were analysed. In all cases saltpetre had been used in their manufacture, and all cheeses contained residual nitrites (average 0.140-0.375 mg%). Nitrates were also determined, in average concn. ranging from 0.615 to 1.120 mg%. The implications of these findings are discussed, e.g. possible formation of carcinogenic nitrosamines during storage of the cheese. Use of saltpetre in cheese manufacture is considered inadvisable, and other methods of preventing cheese blowing are recommended (improving microbiological quality of milk, and use of starters with strains inhibiting gas formation). ADL

37

[Use of nicotinamide in sausage manufacture.]

Shalushkova, L.; Ivanov, K.

Myasnaya Industriya SSSR No. 11, 37-38 (1976) [Ru] [Belorusskoe Otdelenie Vses. Nauchno-issled. Inst. Myasnoi Promyshlennosti, USSR]

The possibility of nicotinamide application during the production of cooked and raw sausages was studied. The following sausages were used: Moskovskii (Grade I), Lyubitel'skii Doktorskii, Moskovskii and Ukrainian cooked sausages and Moskovskii raw sausages. 5 mg% nitrite was added to the curing mixture for soft sausages, 7.5 mg% nitrite for cooked sausages and 7.7 and 10 mg% for raw sausages. The effect of different additions of nitrites on sausage quality was studied. An intense and stable colour was achieved only when 5-7.5 mg% nitrite was added to the emulsion. The residual

content of nitrite amounted to 2.25-3.75 mg%. The addition of nicotinamide in combination with nitrite reduced nitrite content by a factor of 3. Colour intensity and stability of sausages manufactured with the addition of nicotinamide were better than those of controls. The addition of a negligible quantity of nitrite in combination with nicotinamide did not substantially affect the residual microflora in soft sausages; 1 g of the product contained 200-1200 microorganisms. STI

38

[Nitrosamines in meat products containing nitrates and nitrites. I. Matured sausages.]

Panizzi, A.; Luppi, G.; Caserio, G.

Industria Alimentari 16 (7/8) 105-108 (1977) [25 ref. It] [Lab. Chimici Citterio SPA, Rho, Italy]

Contents of (i) nitrates and (ii) nitrites were determined by the method of Follett & Ratcliff [Journal of the Science of Food and Agriculture (1963) 14 (3) 138] in 111 samples of mature raw salami, 83 of them Italian, and 28 imported. Distribution frequencies of (i) and (ii) contents are tabulated. Mean values for (i) and (ii) in Italian salami were, resp. 21 p.p.m. (range, <25 - ≤ 60 p.p.m.) and 4 p.p.m. (range, 0 - ≤ 25 p.p.m.). Corresponding values for imported salami were 50 p.p.m. (range <25 -315 p.p.m.) and 6 p.p.m. (range, 0 - ≤ 25 p.p.m.). It is concluded on the basis of these findings and review of the literature that there is no danger of formation of nitrosamines in Italian salami in view of legal restrictions on use of nitrates and nitrites in their manufacture. SKK

39

Nitrosamines in cured meat products. [Lecture] Sen, N. P.; Iyengar, J. R.; Miles, W. F.; Panalaks, T.

IARC Scientific Publications No. 14, 333-342 (1976) [12 ref. En] [Food Res. Lab., Health Protection Branch, Dep. of Nat. Health & Welfare, Ottawa, Canada]

100 samples of specially selected spiced meat products (e.g. sausages, salami, bologna, wieners, meat loaf, canned luncheon meat) were analysed for nitrate, nitrite and volatile nitrosamines. None of the samples contained high nitrosamine levels but many contained traces, generally in the range 2-50 $\mu\text{g}/\text{kg}$. Some contained as many as 4 nitrosamines, viz. nitrosodimethylamine, nitrosodiethylamine, nitrosopiperidine and nitrosopyrrolidine. A few samples were re-analysed after storage for 2 wk at 4° or -20°C ; no significant change in nitrosamine levels was detected. The identity of the nitrosamines was confirmed by GLC-high resolution MS. [See FSTA (1978) 10 5C147.] AS

40

Volatile nitrosamines in fried bacon. [Lecture]

Gough, T. A.; Walters, C. L.

IARC Scientific Publications No. 14, 195-203 (1976) [5 ref. En] [Lab. of the Gov. Chem., London, UK]

The effect of changing the initial levels of nitrite (100 and 200 mg/kg) and nitrate (0, 50, 250 and 500 mg/kg) in the cures for bacon (backs and collars) was determined, as was the effect of combinations of storage temp. and time (5°C for ≤ 36 days, 15°C for ≤ 21 days, and 25°C for 8 days). The amount of nitrosopyrrolidine (NPy) and nitrosodimethylamine (NDMA) occurring in the fried bacon was determined, and their relative distribution in cooked bacon, its cooked-out fat and in the vapours produced during frying were measured. Results, which are presented in tables, show that NPy concn. in cooked bacon were generally higher in high-nitrite samples than in low-nitrite ones, and tended to decrease with storage time, as did the nitrite levels. There was no apparent correlation between NPy concn. and storage temp. (variations were random), or between NPy concn. and initial nitrate level. Distribution of NPy and NDMA was determined in 18 bacons cured with nitrite levels of 100 and 200 mg/kg and nitrate levels of 0 and 500 mg/kg, stored at 5°C for 1-36 days. Higher contents of NPy and NDMA in cooked bacon and its cooked-out fat were associated with high-nitrite cures, but no correlation was found between nitrosamine concn. and initial nitrate level. There was a higher proportion of NPy and NDMA in cooked-out fat than in cooked bacon, but by far the greatest amounts were lost in the vapour produced during cooking (histograms given). [See FSTA (1978) 10 5C147.] AL

41

[Nitrates, nitrites and nitrosamines in milk and milk products - methods of their determination.] Nitraty, nitrity i nitrozaminy moloča i molochnykh produktov, metody ikh opredeleniya. [Book] Samodurov, V. A.; Prigorov, N. I.; Deryugina, V. A.

37pp. (1977) [75 ref. Ru] Moscow, USSR; VNI Maslodel'noi i Syrodel'noi Promyshlennosti

Results of studies on the presence of nitrates, nitrites and nitrosamines in milk products are given with data on their concn. in the different products.

Carcinogenic properties of nitrosamines and possible pathways of their entry into the organisms are examined. Examples of the detection of these 3 compounds in cheese during ripening are shown. Modern methods for their detn. are presented.

FL

42

[Determination of nitrate in dried milk products. I. Determination after reduction with metallic cadmium.] Bestimmung des Nitratgehaltes getrockneter Milchprodukte. I. Bestimmung nach Reduktion mit metallischem Cadmium.

Mrowetz, G.; Klostermeyer, H.

Milchwissenschaft 32 (11) 647-650 (1977) [6 ref. De, en] [Inst. für Chem., Bundesanstalt für Milchwissenschaft, Kiel, Federal Republic of Germany]

Collaborative experiments in 14 laboratories

using the version of the Cd-reduction method recommended by AOAC, ISO and IDF for nitrate detn. gave widely divergent values in tests on 4 samples of dried whey (ranges of 37-167, 260-600, 480-1026 and 150-924 mg/kg resp.). A version of the method suitable for dried milk products is described in detail; it is based on precipitation of fat and protein from the aqueous solution of the sample with potassium ferrocyanide and ZnSO_4 solutions, reduction of nitrate in the filtrate to nitrite on a Cd column (illustrated), formation of a red azo dye with sulphanilamide and N-(1-naphthyl)ethylenediamine dihydrochloride and photometric detn. at 540 nm. For 10 replicates of nitrate detn. in a mixture containing 40% dried skim-milk and 27% dried sweet whey, the range was 157-163 mg/kg; recoveries of 50, 100 or 150 $\mu\text{g NO}_3^-$ added to 1 g dried skim-milk were slightly over 100%. The following mean values with ranges were found (mg/kg): 8 samples of spray-dried skim-milk, 12 (1-37); 15 of roller-dried skim milk, 22 (2-75); 5 of dried whey, 523 (5-2150); and 37 of mixed dried milk-product feed, 79 (2-860). [See following abstr. for part II.] SKK

43

[Determination of nitrate in dried milk products. II. Rapid determination with diphenylamine and comparison with the cadmium reduction method.]

Bestimmung des Nitratgehaltes getrockneter Milchprodukte. II. Schnellbestimmung mit Diphenylamin und Vergleich mit der Cadmium-Reduktionsmethode.

Mrowetz, G.; Klostermeyer, H.

Milchwissenschaft 32 (12) 705-708 (1977) [7 ref. De, en] [Inst. für Chem., Bundesanstalt für Milchwissenschaft, Kiel, Federal Republic of Germany]

The diphenylamine method, described in detail and used previously in the authors' Institute with satisfactory results for detn. of nitrate in cheese [see Kay & Mrowetz, *Milchwissenschaft* (1960) 15, 550 & Kieler Milchwirtschaftliche Forschungsberichte (1961) 13, 43], is based on removal of fat and protein from sample [see preceding abstr.], formation of blue colour with diphenylamine in H_2SO_4 solution and photometric detn. at 610 nm. Colour intensity is reduced in the presence of sugars, but the reduction increases rectilinearly with increase in lactose or glucose content and can be compensated by using standard curves.

Relationships with galactose, sucrose and, particularly, fructose are non-linear; the method is therefore unsuitable for infant foods. Results obtained by this method were in good agreement for the products described in part I [see preceding abstr.] with, though slightly lower than, those of the Cd reduction method. It is considered that for nitrate contents in such products of > 10 mg/kg, the diphenylamine method is a rapid and satisfactory routine procedure. [See preceding abstr. for part I.] SKK

44

Chemical effects of smoke-processing on frankfurter manufacture and storage characteristics.
Sink, J. D.; Hsu, L. A.

Journal of Food Science 42 (6) 1489-1491, 1503 (1977) [31 ref. En] [Meat Lab., Dep. of Food Sci., Pennsylvania State Univ., University Park, Pennsylvania 16802, USA]

Frankfurters (franks) were made by standard commercial practices except for the smoke treatment which involved 4 different methods: solid smoke-aerosol, liquid smoke-aerosol, liquid smoke-external dip, and liquid smoke-internal mix. For control purposes, franks were prepared without any smoke treatment. All franks were packaged and stored at 5°C with samples removed for analyses weekly for 3 wk. Method of smoke application did affect the processed wt. of the franks. Liquid smoke-aerosol treatment produced the heaviest franks; the liquid smoke-internal mix application produced franks lighter in wt. than the other treatments including the nonsmoked control. Smoke-treatment had no significant effect on the fat or total volatile N (TVN, expressed on a fat-free basis) content of the franks. However, it did affect the amounts of moisture, phenol, free fatty acids (FFA) and TVN as well as the pH and 2-thiobarbituric acid (TBA) values. The use of the liquid smoke-external dip significantly lowered the nitrite content of the franks when compared to all other treatments; the nitrite content of the others did not differ from each other. As the phenol content increased, pH decreased. Generally, storage had no effect on the frankfurter properties evaluated in these studies. However, pH was seen to drop then rise again whereas the amount of FFA rose then fell during the 3-wk period. IFT

45

Producing boneless dry-cured hams with different amounts of curing ingredients.

Kemp, J. D.; Fox, J. D.

Journal of Food Science 42 (6) 1487-1488 (1977) [4 ref. En] [Dep. of Anim. Sci., Univ. of Kentucky, Lexington, Kentucky 40506, USA]

Fresh hams were skinned, boned and partially defatted. A curing mixture of 84.9% salt, 14.2% white sugar and 0.9% sodium nitrite was applied at the rate of either 5% or 7% of the boneless wt. Approx. 50 g of the mixture were placed inside each ham, which was then tightly tied. Half the remaining mixture was applied to the surface and the remaining half again after 4 days. Hams were cured 21 days at 3°C, held 21 days at 21°C for salt equalization, heated to 38°C and smoked for approx. 24 h and aged at 18°C for 4 or 8 wk. Organoleptic evaluations were made, and slices were analysed for salt, moisture and nitrite. Ham yields were not affected by amount of cure but decreased with time. Panel scores were similar for both cures and both times, except for saltiness, and all were highly acceptable. % salt and moisture were similar for both cures but salt increased and water decreased with time. Outer (a strip around the slice

approx. 2.5 cm wide) and inner portions of the slices were similar for salt, but outer portions contained less moisture. Some variations occurred in nitrite levels, but the highest level detected in the outer portion of the 5% cure after 4 wk ageing was only 17.1 p.p.m. Hams not tightly tied developed some internal mould while properly tied ones were free of mould. IFT

46

Distribution of sodium nitrite in adipose tissue during curing.

Goutefongea, R.; Cassens, R. G.; Woolford, G.

Journal of Food Science 42 (6) 1637-1641 (1977) [29 ref. En] [Muscle Biol. Lab., Univ. of Wisconsin, Madison, Wisconsin 53706, USA]

Nitrite reacts with adipose tissue when conditions are similar to those for meat curing. Whole adipose tissue (ground and unground) was subjected to a curing procedure, and it was established that a more homogeneous distribution of nitrite occurred in the ground adipose tissue. 80-90% of the added nitrite was analysable as free nitrite in cured whole adipose tissue. When $\text{Na}^{15}\text{NO}_2$ was used, the recovery of ^{15}N was low and variable; the amount of ^{15}N recovered was found to be dependent on the protein content of the adipose tissue sample. When whole cured adipose tissue was separated into lipid, connective tissue and water phases, free nitrite was detected in each. The results also include analyses for nitrate which was present though in small amounts. ^{15}N from $\text{Na}^{15}\text{NO}_2$ was bound to connective tissue and lipid in low but detectable amounts; this occurred if whole adipose tissue was treated with nitrite and then fractionated or if fractionation was accomplished prior to treatment with nitrite. Experiments on various fatty acids and glycerides showed a binding which was apparently related to the degree of unsaturation. Serious question was raised about the meaning of so-called 'free' or 'residual' nitrite. The importance of protein-bound nitrite was emphasized, and the suggestion was made that some of the bound nitrite is released by sample preparation. The implications of this are discussed. IFT

47

Effects of sodium nitrate and sodium nitrite additions and irradiation processing variables on the color and acceptability of corned beef briskets.
Shults, G. W.; Cohen, J. S.; Howker, J. J.; Wierbicki, E.

Journal of Food Science 42 (6) 1506-1509 (1977) [15 ref. En] [Irradiated Food Products Group, US Army Natick Res. & Development Command, Natick, Massachusetts 01760, USA]

Radappertized corned beef briskets were prepared with and without addition of water-soluble spices using various levels of NaNO_3 (0, 150 and 600 p.p.m.) and NaNO_2 (0, 25 and 150 p.p.m.) and γ -irradiation processed at 3 dose levels (2.5, 3.5 and 4.5 kJ/kg) at 3 irradiation temp. (0°, -30° and -80°C). Sensory characteristics and

preference rating were determined by sensory or consumer-type panels. Colour intensities were determined by expert technological panels and by measurements of reflectance with a tristimulus reflectometer. Increasing the irradiation temp. resulted in decreasing the ratings for the sensory characteristics. Significant differences were found in the ratings for sensory characteristics and preference of samples with high vs. low additions of NaNO_2 and NaNO_3 . Colour intensities decreased when only NaNO_3 (without NaNO_2) or 25 p.p.m. addition of NaNO_2 was used. Colour ratings were significantly affected by irradiation dose and temp. IFT

48

[Nitrite ban not to be recommended in the USA.]
Hoyem, T.

NINF Informasjon 5, 55-59 (1977) [No]

As part of a discussion on the relative position in the USA and Norway regarding use of specific additives to foods, tabulated data are given on the max. permissible concn. of nitrites and nitrates and the min. recommended concn. of (i) ascorbates/isoascorbates in various foods in the 2 countries. These are for USA and Norway, resp. (p.p.m.): nitrites, 120 and 200 in bacon, 156 and 0 in sterile preserves; 156 and 200 in traditional semi-preserves, 100 and 0 in cooked sausages, 100 and 200 in smoked sausages and 156 and 60 in delicatessen products. In neither country is the use of nitrates in these products permitted. In the USA, the min. recommended addition of (i) in these foods in the order named is 500, no min. set, 550, 550, no min. set, and 550; there is no such regulation in force in Norway. The basis of the US recommendation is the fact that (i) has been shown experimentally to block formation of nitrosamines. HBr

49

[Conversion of nitrite and nitrate in meat products.

II. Recovery of added nitrite and nitrate in meat products extracts with the technicon Autoanalyzer.] Zur Kenntnis der Umsetzung von Nitrit und Nitrat in Fleischwaren. II. Die Wiederauffindung von Nitrit- und Nitratzusätzen in Fleischwaren. Extrakten mit dem Technikon Autoanalyzer. Hauser, E.; Weber, V.

Fleischwirtschaft 58 (1) 140-144; 76 (1978) [2 ref. De, en] [Eidgenössisches Veterinäramt, Viktoriastrasse 85, 3000 Bern, Switzerland]

The recovery of NO_2^- and NO_3^- from aqueous extracts of various meat products was investigated in order to show the interference of the matrix of the various extracts with the reaction system, especially the Cd-reducing column. Extracts from 26 meat and fish products, mainly Brühwurst, Kochwurst, Rohwurst (dry sausage) and cured/smoked fish, were examined for recovery of 5-45 p.p.m. added NaNO_2 and NaNO_3 by the technicon Autoanalyzer. Tabulated results showed mean NaNO_2 recoveries of 90.4% (cured smoked

fish) to 106.8% (liver sausage for spreading), and indicated no relation between recovery rate and composition of the product; mean recovery ($n = 147$) was 99.9%, s.d. $\pm 4.87\%$. For NaNO_3 , mean recovery ($n = 117$) was 79.5%, s.d. $\pm 20.98\%$; range of recovery was 58.3% (fish) to 89.1% (Kochwurst), or for single samples 40.8% (smoked herring) to 97.7% (Italian salami). No relation was observed between the recovery and either composition or production method. [See FSTA (1975) 7 9S1222 for part I.] RM

50

Nitrite additives - harmful or necessary? [Review]
Ravesi, E. M.

Marine Fisheries Review, National Oceanic and Atmospheric Administration 38 (4) 24-30 (1976) [40 ref. En] [Northeast Utilization Res. Cent., Nat. Marine Fisheries Service, NOAA, Emerson Avenue, PO Box 61, Gloucester, Massachusetts 01930, USA]

The question of whether the continued use of nitrites in the preparation of smoke-cured fishery products and processed meat products is necessary for the production of a product safe from deadly bacterial toxin (responsible for outbreaks of botulism) or whether their presence is responsible for the occurrence and formation of highly potent carcinogens in foods and/or the bodies of consumers is reviewed and discussed. AL

51

Occurrence of nitrate, nitrite, dimethylamine, and dimethylnitrosamine in some fermented Nigerian beverages.

Bassir, O.; Maduagwu, E. N.

Journal of Agricultural and Food Chemistry 26 (1) 200-203 (1978) [31 ref. En] [Biochem. Dep., Univ. of Ibadan, Ibadan, Nigeria]

The contents of NO_3^- , NO_2^- and dimethylamine (DMA) were determined in various fermented Nigerian beverages (palm-wine; burukutu and pito, fermented cereal beverages; ogogoro, a palm-wine or molasses distillate; and nono, skimmed fermented cow's milk). Results are tabulated for beverages purchased from 15 locations in Kwara and Benue States. NO_3^- was found in 80% of the beverages (i.e. in all but the ogogoro samples) in concn. of 6-91 p.p.m.; NO_2^- was present in 60% of the beverages (never in ogogoro) at 0.86-2.9 p.p.m. DMA was present in all beverages at 4.06-31.6 p.p.m. The limits of detection for NO_3^- , NO_2^- and DMA were 1, 0.2 and 2 $\mu\text{g}/\text{ml}$, resp. Dimethyl nitrosamine (DMN) was detected in 1 sample of palm-wine at 0.6 ng/ml. NO_3^- , NO_2^- and DMA were determined colorimetrically and spectrophotometrically, DMN was determined by TLC and GLC and confirmed by MS. DIH

52

Factors affecting nitrate content in field-grown vegetables.

Vulsteke, G.; Biston, R.

Qualitas Plantarum - Plant Foods for Human Nutrition 28 (1) 71-87 (1978) [6 ref. En, fr, de] [Provinciaal Centrum voor Land- en Tuinbouw, 8810 Beitem-Roeselare, Belgium]

Studies were conducted during the period 1968-1975 on factors influencing the nitrate content of snap beans, carrots and celery. Factors investigated were: variety; year of production; sowing date; plant density; N fertilization (N source, level of application, and time of application); stage of maturity at harvest; size of the vegetable; and blanching. Tables of results are given. The results show that: varieties differ in nitrate content; differences attributable to year of production are greater than those attributable to var.; nitrate concn. increases with delay in sowing time and increasing plant density; nitrate concn. tended to increase with increasing N level applied; nitrate level decreases with increasing maturity at harvest; blanching reduces nitrate content; and size grade has little effect on nitrate content. AJDW

53

[Addition of haemoglobin to stabilize the colour of smoked products and to reduce the addition of nitrite.]

Tsimbalova, N. M.; Inzhlyants, A. A.; Petrenko, O. P.; Toptei, M. I.; Ivanchenko, L. V.

Pishchevaya Promyshlennost' Respublikanskii Mezhdovedomstvennyi Nauchno-tekhnicheskii Sbornik No. 23, 70-75 (1977) [Ru]

Addition of blood cell components into smoked products acts as colour improver and stabilizer; the nitrite addition can consequently be reduced to 30%. Best results have been obtained with 0.2-0.3% concn. of haemoglobin preparation in the sausage emulsion. STI

54

Effect of nitrite and erythorbate on recovery of *Clostridium perfringens* spores in cured pork.

Sauter, E. A.; Kemp, J. D.; Langlois, B. E. *Journal of Food Science* 42 (6) 1678-1679 (1977) [15 ref. En] [Dep. of Anim. Sci., Foods Sect., Univ. of Kentucky, Lexington, Kentucky 40506, USA]

Fresh pork shoulders were boned and ground through a 12.7 mm plate, packed in 1-kg packages, frozen at -28.9°C and stored at -17.8°C for 2 wk. The frozen pork samples were thawed for 24 h at 3°C, then blended with a curing mixture consisting of 6 parts NaCl and 1 part sugar at a rate of 47.5 g/kg meat, with erythorbate and NaNO₂ added to give levels of 0, 183, 366 or 550 p.p.m. erythorbate and 0, 50, 100, 150 or 200 p.p.m. nitrite in the meat. The pork was then inoculated at the rate of 11 spores of *Clostridium perfringens* (UK92)/g, packed in quart jars (500/g jar) and cured for 2 wk at 1-4°C followed by 2 wk salt equalization at

12.8°C. Enumeration for *C. perfringens* began at this time and continued on alternate weeks during the 6-wk ageing period. Recovery of *C. perfringens* spores was significantly reduced by NaNO₂. After 4 wk, 80% of the inoculated spores were recovered from samples with no added nitrite, while only about one-third of the spores were recovered from samples with the lowest level of NaNO₂. Higher levels of nitrite and increased ageing time reduced the number of spores recovered. At 10 wk, recovery was 38.0, 12.0, 5.4, 3.6 and 0.9% of inoculated spores, resp., for 0, 50, 100, 150 and 200 p.p.m. NaNO₂. Sodium erythorbate had no significant effect on recovery of spores. Nitrite levels in the meat decreased rapidly, with <60% of initial levels remaining after 24 h. Only about 10% of initial concn. were present after 4 wk. Results generally were similar for survival of *C. perfringens* spores and for nitrite losses when ground pork samples were dry-cured in stockinettes and aged for the same time and at the same temp. as those cured in jars. IFT

55

Precursors of dimethylnitrosamine in fried bacon.

Gray, J. I.; Collins, M. E.; MacDonald, B. *Journal of Food Protection* 41 (1) 31-35 (1978) [21 ref. En] [Dep. of Food Sci., Univ. of Guelph, Guelph, Ontario N1G 2W1, Canada]

The formation of dimethylnitrosamine (DMN) was studied in model systems and in fried pork samples. The model systems used were (i) a low moisture carboxymethylcellulose system (simulating the dry surface of cured meat products), and (ii) an oil system heated under reflux. Studies of the effect of pH on DMN formation in a (i) system containing 5mM NaNO₂ + 1mM precursor (dimethylamine (DMA), trimethylamine, sarcosine or choline chloride) showed that max. formation of DMN was given at pH 3.4; sarcosine and DMA were the main precursors (3.19 and 2.35% conversion at pH 3.4, after 2 h at 150°C, resp.). The effect of temp. (100-200°C) on the formation of DMN in the (i) system was studied with sarcosine; max. formation was at 140°C (3.23% conversion to DMN at pH 3.4 after 2 h). Higher temp. were thought to volatilize DMN; DMN formation in the (ii) system increased with temp., 5.07% sarcosine in the presence of 5mM NaNO₂ was converted to DMN after 15 min at 200°C. 22.29% of N-nitrosarcosine (at 1mM initially) was converted to DMN after 15 min at 200°C in a (ii) system. Phosphoryl choline chloride and soy lecithin were also studied in a (ii) system at 1mM concn. with NaNO₂ at 5mM, their respective % conversion to DMN after 30 min at 180°C was 0.99 and 0.43. Formation of DMN from these precursors increased with temp. in the range 120°-180°C. Formation of DMN, and distribution between vapour and meat phases, was studied with fried pork samples containing various amounts of NaNO₂ (0-1000 p.p.m.) and added precursors (0,

sarcosine at 200 p.p.m. or phosphoryl choline chloride at 1000 p.p.m.). Formation of DMN increased with temp., and NaNO_2 and precursor concn. but yields were much lower than in the (ii) system, and $\leq 80\%$ of the DMN was found in the vapour phase. Highest DMN concn. in the fried material was 135 ng/(g pork before heating) from sarcosine. DIH

56

Formation of N-nitrosopyrrolidine in fried bacon. Gray, J. I.; Collins, M. E.

Journal of Food Protection **41** (1) 36-39 (1978) [25 ref. En] [Dep. of Food Sci., Univ. of Guelph, Guelph, Ontario N1G 2W1, Canada]

Formation of N-nitrosopyrrolidine (N-Pyr) from proline and N-nitrosoproline (N-Pro) was investigated by cooking pork slices to which these precursors had been added. When the cooking system was heated in an oil bath at 200°C for 12 min, 0.33 and 2.18% yields of the N-nitrosamine were obtained from proline and N-Pro, resp. The N-Pro contents of pork slices to which 2 levels of nitrite were added were determined after 1 and 8 days of storage at 2°C . Results indicate that the formation of N-Pro occurs at such a rate that 1 day after addition of nitrite there is theoretically sufficient N-Pro formed to account for the quantities of N-Pyr isolated from cooked bacon. However, the rate of decarboxylation of the initial N-Pro in raw bacon is not great enough to account for the N-Pyr isolated from cooked bacon. [See also preceding abstr.]. AS

57

Fate of nitrite added to cured meat. III. Reaction between nitrite and low salt-soluble, diffusible fraction of meat. Partial purification and some properties of unknown reaction products. Miwa, M.; Okitani, A.; Kurata, T.; Fujimaki, M. *Agricultural and Biological Chemistry* **42** (1) 101-106 (1978) [17 ref. En] [Dep. of Agric. Chem., Univ. of Tokyo, Tokyo, Japan]

The reaction products between ^{15}N -nitrite and the 0.05M NaCl-soluble fraction of meat were chromatographed on a Sephadex G-15 column. The unidentified ^{15}N compound(s), which correspond to about 25% of added nitrite- ^{15}N , eluted as 1 peak, and separated from peptides, nitrite and nitrate. These compounds had a tendency to be absorbed to Sephadex gel, and eluted after nitrite and nitrate. They had no UV absorption from 240 to 320 nm, and were not nucleotides, amino acids or peptides. They were subjected to TLC and paper electrophoresis; paper electrophoresis showed that they were strongly acidic compounds. [See FSTA (1977) 9 2S182 for part II.] AS

58

[Nitrites and nitrates in meat products. Their state in foods and their transformations in the alimentary tract.] [Review] Cantoni, C.; Bianchi, M. A.

Rivista della Societa Italiana di Scienza dell'Alimentazione **7** (1) 65-78 (1978) [158 ref.

It] [Istituto di Ispezione degli Alimenti di Origine Animale, Univ. degli Studi di Milano, Milan, Italy]

Aspects discussed in this review include the following: reactions of nitrite and nitrate with meat constituents; effects on the aroma of the product; effects on the microflora of cured meats, with special reference to control of pathogens; nitrosamine formation in cured meats and possible methods for its minimization; the possibility of nitrosamine formation in the stomach; the relative rates of nitrosation of various amines and amino acids; the nitrate and nitrite contents of Italian cured meat products; and permitted levels of nitrates and nitrites in foods in various European countries, Japan, Canada and the USA. AJDW

59

The nitrosation of foods.

Newton, B. E.

Dissertation Abstracts International, C **37** (3) 603 (1977) [En] [Univ. of Surrey, Guildford, Surrey, UK]

A quantitative measure of the amounts of nitrosatable compounds present in various foods was obtained by reacting whole foods with a large excess of NaNO_2 and studying the amount of N-nitroso compounds formed. This treatment produced several volatile N-nitrosamines, identified by combined gas chromatography-MS, although the major products were non-volatile nitrosamines of unknown identity. The same foods were exposed to low concn. of NaNO_2 (10 and 100 p.p.m.) in a medium simulating the human stomach to measure the probable nitrosation that may occur in the human stomach, after a nitrite-containing meal is consumed. Nitrosation of foods did occur, the products being mainly non-volatile N-nitroso compounds. In vivo studies were performed, where nitrite-containing meals were fed to humans. No nitrosation could be detected and it was observed that the ingested nitrite disappeared rapidly from the stomach contents. Catalysis of nitrosations by various biological anions was examined, but none produced a marked catalytic effect and thiocyanate remained the most effective catalyst. Concn. of thiocyanate, comparable to levels found in human saliva, were incorporated into incubations of food with nitrite in the simulated stomach medium, but there was no great enhancement in the amount of nitrosation that occurred. The possible nitrosation of peptide bonds was studied, using glycyl glycine. It was demonstrated that an N-nitroso derivative could also be nitrosated, but the nature of the constituent amino acids did not markedly affect the nitrosation. Several amines present in foods, were examined for their potential for nitrosation. AS

60

Determination of nitrate and nitrite in whey cheese. Kaneda, Y.; Iwaida, M.

Journal of the Food Hygienic Society of Japan [Shokuhin Eiseigaku Zasshi] **18** (5) 470-473

(1977) [2 ref. En] [Hyogo Prefecture Inst. of Public Health, Arata-cho, Hyogo-ku, Kobe, Japan]

In 3 lots of Mysost-type whey cheese, nitrite was analysed by the diazotization-coupling reaction while the cadmium column reduction method was used for nitrate analysis. Nitrite content was 1.8-2.7 mg/kg cheese and nitrate content was 49-390 mg/kg cheese. TM

61

[Nitrosamines in meat products containing nitrates and nitrites. II. Italian mortadella.]

Caserio, G.; Luppi, G.; Panizzi, A.

Industria Alimentari 17 (1) 45-46 (1978) [17 ref. It] [Cattedra di Patologia Anim. e Ispezione delle Carni, Univ. di Milano, Milan, Italy]

Following previous work on the nitrite and nitrate contents of Italian salami [see FSTA (1978) 10 5S663] the survey was extended to Italian mortadella products to assess the possible risk of nitrosamine formation (assumed to depend on the quantity of residual nitrite and nitrate) in view of the cooking temp. of 75°C at the centre. Nitrate and nitrite contents were determined in 90 samples of mortadella taken over 4 months, representing normal products manufactured with 150 p.p.m. NaNO₂ but with no addition of nitrate. Results are tabulated, with distribution in ranges between nil and 30 p.p.m. nitrite and 50 p.p.m. nitrate. Average of all values was 9.5 p.p.m. nitrite and 24.14 p.p.m. nitrate. All samples were well below the FAO/WHO recommended max. and the US limit (for cooked products) of 100 p.p.m., and satisfy the legal requirements of various other countries. ELC

62

Enhancing nitrite inhibition of *Clostridium botulinum* with isoascorbate in perishable canned cured meat.

Tompkin, R. B.; Christiansen, L. N.; Shaparis, A. B.

Applied and Environmental Microbiology 35 (1) 59-61 (1978) [11 ref. En] [Swift & Co., Res. & Development Cent., Oak Brook, Illinois 60521, USA]

Perishable canned comminuted cured pork was formulated with salt, water and sugar, inoculated, processed and chilled. 0.02% (meat wt. basis) sodium isoascorbate and 0, 50 or 156 µg/g (meat wt. basis) NaNO₂ were added. Cans of meat were inoculated with 5 type A (33A, 36A, 52A, 77A and 12885A) and 5 type B (ATCC 7949, 41B, 53B, 213B and Lamanna B) strains of *Clostridium botulinum*, using a target level of 100 spores/g of product. 25 cans of inoculated product/test variable were incubated at 27°C for ≤ 110 days and removed as they swelled. Spore levels, toxin assays and chemical composition were determined. Addition of sodium isoascorbate to perishable canned comminuted cured meat markedly enhanced the efficacy of nitrite against *Clostridium botulinum*. It was found that initial addition of 50 µg NaNO₂/g isoascorbate was as effective as 156 µg NaNO₂/g alone. SP

63

The relation between enzymatic and non-enzymatic processes in the course of nitrates and nitrites reduction in cured meat and meat products.

[Lecture]

Zatocil, O.

Proceedings of the European Meeting of Meat Research Workers No. 23, F11:1-F11:22 (1977) [12 ref. En, Ru] [Dep. of Food Hygiene & Tech., Univ. of Vet. Med., Brno, Czechoslovakia]

The microbial reduction of nitrates and nitrites was analysed as well as the non-enzymic decomposition of nitrites and reduction of NO₂ in the muscle, in order to study nitric oxide production during the curing of meat products. It was found to be an oversimplification or an error to consider NO to be the product of simple reduction of nitrates and nitrites. NO is not the common product of muscle reduction of nitrites; it accumulates during the enzymic reduction of NO₂ in muscle tissue or by its chemical hydrolysis. Both oxides were found to be the products of hydrolysis of nitrites and nitrous acid, and which were found to be of enzymic origin. They were shown to be the basis for all technological, as well as undesirable, effects accompanying the application of nitrates and nitrites during meat processing. [See FSTA (1978) 10 8S1048.] STI

64

[Effect of nitrite conversion products on the growth of microorganisms.] [Lecture]

Mirna, A.; Coretti, K.

Proceedings of the European Meeting of Meat Research Workers No. 23, L1:1-L1:11 (1977) [17 ref. Ru, De] [Bundesanstalt für Fleischforschung, D 8650 Kulmbach, Federal Republic of Germany]

The inhibiting action of reaction products of ether soluble nitrites with unsaturated aliphatic compounds (crotonic acid, crotonaldehyde, sorbic acid) on the growth of *Enterobacter liquefaciens*, *Escherichia coli*, *Staphylococcus aureus* and *Micrococcus* sp. was studied using liquid media. The reaction product of nitrite and sorbic acid (ethylnitrolic acid) had an inhibiting effect at a concn. of only 10 p.p.m. concn. The deamination of amino sugars (found in the connective tissues) combined with the reaction with nitrite resulted in sugar aldehydes as e.g. 2,5-anhydro-D-mannose, which is easily converted to 5-hydroxymethyl-2-furfural. Sugar aldehydes are also formed when sugars are heated in acid media. The inhibiting action of 5-hydroxymethyl-2-furfural was pronounced against *Staphylococcus aureus* and micrococci, even at a concn. of only 5 p.p.m. [See FSTA (1978) 10 8S1048.] STI

65

Inhibition of *Clostridium botulinum* with nitrite in meat products. [Lecture]

Lee, S. H.; Cassens, R. G.; Sugiyama, H.

Proceedings of the European Meeting of Meat Research Workers No. 23, L14:1-L14:20 (1977) [16 ref. En, Ru] [Muscle Biology Lab., Univ. of

Wisconsin, Madison, Wisconsin, USA]

Various amounts (0, 50, 100, 150, 200 or 300 p.p.m.) of nitrite were added to ground pork, which was then canned and heated at 90°, 100° or 110°C. Silver lactate was used to block endogenous sulphhydryl groups in some meat samples before the addition of nitrite. Inhibition was studied by inoculating spores of *Clostridium botulinum* into cans containing little nitrite and stored for 8 wk, or into meat homogenates prepared from canned meat and adjusted to 30 p.p.m. nitrite content. Swelling was observed in cans stored at 22°C and gas production was observed in homogenates stored at 30°C. In both cases nitrite caused inhibition. The inhibition was greater if increased levels were added initially to the meat, and it was lowered in meat stored for 6 wk compared with that stored for 1 day. Similar results were obtained from meat treated with silver ions to block endogenous sulphhydryl groups. This indicates that sulphhydryl groups are not necessary for formation of the inhibitor in cured meat products. [See FSTA (1978) 10 8S1048.] STI

66

The effect of sodium nitrite on the changes of sarcoplasm proteins in muscle tissue. [Lecture] Bodiev, R. D.; Makushkin, E. O.; Chirkina, T. F. *Proceedings of the European Meeting of Meat Research Workers* No. 23, N16:1-N16:10 (1977) [6 ref. En, Ru] [Vostochno-Sibirskii Tekh. Inst., Ulan-Ude, USSR]

It was established that nitrites could form compounds both with myoglobin and other muscle sarcoplasmic proteins. Immunological similarity was established between nitroproteins and nitrosamines. It was therefore necessary to study the reactions of nitrites with meat sarcoplasmic proteins in the course of meat curing. Using agar and polyacrylamide gel electrophoresis, information was obtained on changes taking place in the composition of the individual fractions of pork and beef sarcoplasmic proteins during curing with and without nitrites. The presence of nitrite-modified protein molecules in the individual fractions was statistically significant. [See FSTA (1978) 10 8S1048.] STI

67

Nitrate determination in cheese by use of ion selective electrode.

Kaneda, Y.; Kanamori, T.; Iwaida, M. *Journal of Hygienic Chemistry [Eisei Kagaku]* 23 (5) 301-306 (1977) [8 ref. En] [Public Health Inst. of Hyogo Prefecture, 2-1, Arata-cho, Hyogo-ku, Kobe, Japan]

In order to remove fat and protein and other interfering substances, 20 g grated cheese were homogenized in 90 ml water, heated in a boiling water bath for 1 h, cooled at 5°C for 1 h and centrifuged. The supernatant was treated with Ag or Al resins (prepared by adding AgNO_3 or $\text{Al}_2(\text{SO}_4)_3$ to Dowex 50 W \times 8) and filtered. Nitrate was determined in the filtrate by means of

an Orion model 93-07 nitrate ion-selective electrode and calculated from readings taken before and after addition of 500 p.p.m. of nitrate. The lower limit of detection for the method was 5 mg NO_3^-/kg cheese. NO_3^- contents (mg/kg) measured by this method in some dairy products were: New Zealand Cheddar cheese, 19.3-24.6; Danish Samsoc cheese, 24.5-27.7; Danish cream, 12.8-16.8; whey, 13.9; smoked butter cream (W. Germany), 37.6; and natural plain cream (W. Germany), 43.2. MEG

68

Effects of processing treatments on chemical and organoleptic properties of corned beef.

Reagan, J. O.; Carpenter, J. A.; Blanchard, C. P. *Journal of Food Science* 43 (1) 270-271 (1978) [4 ref. En] [Dep. of Food Sci., Univ. of Georgia, Athens, Georgia 30602, USA]

18 beef briskets obtained from USDA Choice carcasses were boned and randomly assigned to either a 4°C or -10°C storage treatment for 72 h. The frozen briskets were then placed in a 4°C cooler and held until attaining an internal temp. of 3-4°C. After thawing, all briskets were pumped to 0, 10 or 20% of their green wt. (3 briskets/group/pumping treatment) and held for 2 days in a cover pickle of the same salinity. Wt. losses were determined after a 2-day immersion period and chemical and organoleptic samples were obtained 2, 7 and 14 days after pumping. These data indicate that processing yields were not significantly affected by degree of pump, storage at -10°C prior to processing or sp. gr. values. Residual nitrite values were not significantly affected by freezing treatments prior to processing or sp. gr. values. Nitrite levels were similar at 2 and 14 days after pumping at all pumping levels. After 7 days storage, residual nitrite levels were <50 p.p.m. in all briskets. Sensory ratings for tenderness and juiciness increased as time after pumping increased. IFT

69

Influence of tumbling and sodium tripolyphosphate on salt and nitrite distribution on porcine muscle. Krause, R. J.; Plimpton, R. F.; Ockerman, H. W.; Cahill, V. R.

Journal of Food Science 43 (1) 190-192 (1978) [20 ref. En] [Dep. of Anim. Sci., Ohio State Univ., Columbus, Ohio 43210, USA]

The effect of tumbling and sodium tripolyphosphate (STP) on the migration of salt and nitrite in pork muscle tissue was studied using semimembranosus muscles from 20 matched hams. Uniform sections of these muscles were injected with a column of cure placed in the geometric centre of the muscle section perpendicular to the muscle fibres. Portions of these muscle samples were subsequently analysed after tumbling or holding for extent of cooked cured colour development. Uncooked portions were analysed for salt and nitrite concn. at specific distances from the injection site. Both STP and tumbling

independently significantly increased the migration of salt and nitrite and resulted in a significant increase in colour development. Although % cured colour area was significantly increased, both tumbling and STP increased the residual nitrite content. STP added to the effect of tumbling on the % of cured area. IFT

70

[Physicochemical analysis of drinking water. Determination of nitrites.]

Czechoslovakia, Urad pro Normalizaci a Mereni
Czechoslovak Standard CSN 83 0520, Cast 23,
4pp. (1976) [Cs]

The method, which involves photometry using sulphanilic acid and N-(1-naphthyl)-ethyldiamine hydrochloride, can determine nitrites in drinking water at concn. of 0.001-0.050 mg/l. HBr

71

[Physicochemical analysis of drinking water. Determination of nitrates.]

Czechoslovakia, Urad pro Normalizaci a Mereni
Czechoslovak Standard CSN 83 0520, Cast 24,
3pp. (1976) [Cs]

The method, which involves photometry with sodium salicylate, can determine nitrates in drinking water at concn. >0.5 mg/l. HBr

72

[Determination of nitrates in foods by a nitrate-specific electrode.]

Merget, C.; Bonnoit, J.-M.

Analusis 6 (4) 164-172 (1978) [44 ref. Fr, en]

[Carnaud SA, 65 Avenue Ed.-Vaillant, 92103
Boulogne-sur-Seine, France]

A method was developed for detn. of NO_3^- in foods by means of a specific electrode. Study of the effects of pH and ionic strength on electrode response showed that the use of known additions gave more accurate results than direct detn. by means of an electrode calibration curve. Detailed descriptions of the equipment and operation are given. Recovery tests with 4, 40 and 400 mg NO_3^- /l. gave recoveries of 90, 102.3 and 109% in Cl-free solution, 123.5, 105.0 and 108.8% in presence of Cl⁻ (up to 10 g NaCl/l.) and accuracy of 1-2% except for very low concn. (where it was 11%). Limit of detection was about 1 mg/l. The validity of the method was confirmed with tomato concentrate and celery hearts. The use of a $\text{Hg}/\text{Hg}_2\text{SO}_4$ reference electrode, micropipettes, known NO_3^- addition, and controlled elimination of Cl⁻ meant that this method can be used for fast and easy detn. of NO_3^- in foods, and requires no sophisticated equipment. RM

73

[Evaluation of nitrate, nitrite and N-nitroso compounds.] Zur Bewertung von Nitrat, Nitrit und N-Nitrosoverbindungen. [Review]

Sieber, R.; Blanc, B.

Deutsche Molkerei-Zeitung 99 (8) 240-242, 244-246, 248; (9) 278-280, 282 (1978) [150 ref. De]

[Eidgenössische Forschungsanstalt für
Milchwirtschaft, CH-3097 Liebefeld-Bern,
Switzerland]

The authors review the literature to date on the significance, from the health hazard point of view, of the presence of nitrate and nitrite in food materials as factors in the formation of carcinogenic N-nitrosamines. Data for nitrate and nitrite contents of various foods, especially dairy products, are presented, and WHO recommended limits for daily intake of each are set out. Conditions favouring formation of N-nitrosamines by interaction of nitrite and secondary amines during preparation and during subsequent digestion of foods are discussed. Attainment of satisfactory min. levels of nitrosamines would appear to depend on elimination of processing methods which favour formation of nitrosamines; and availability, for control purposes, of foods known to be low in nitrate-nitrite and in nitrosamine-forming amines. GTP

74

[Effect of a dose of nitrate on the salivary and gastric nitrite of man.]

Klein, D.; Gaconnet, N.; Poullain, B.; Debry, G.

Food and Cosmetics Toxicology 16 (2) 111-115

(1978) [18 ref. Fr, en] [Dep. de Nutr. et des
Maladies Métaboliques de l'Univ. de Nancy I,
Nancy, France]

Following ingestion of a test meal containing 112 mg nitrate, the rate of evolution of salivary and gastric nitrite and nitrate was studied in 2 groups of volunteers. The possible relevance of the findings to nitrosamine formation in vivo is discussed. VJG

75

Influence of type of bacterial strain in cheese starter on nitrate reduction in the cheese.

Przybyłowski, P.; Kiszka, J.; Palich, P.

XX International Dairy Congress E, 547-548

(1978) [En] [Inst. of Food Eng. & Biotech., Acad.
of Agric. & Tech., Olsztyn, Poland]

Selection of suitable bacterial strains in starters used for manufacture of Edam, Tilsit and Gouda cheeses enabled the nitrate reduction rate to be controlled and the quantity of nitrates present in the ripened cheeses to be reduced. [See FSTA (1978) 10 10P1408.] MEG

76

Gas chromatographic determination of nitrate and nitrite in cheese.

Toyoda, M.; Suzuki, H.; Ito, Y.; Iwaida, M.
XX International Dairy Congress E, 387-388
 (1978) [1 ref. En] [Nat. Inst. of Hygienic Sci.,
 Osaka, Japan]

Nitrate and nitrite are extracted from cheese, the nitrite is destroyed with sulphanilamide, and the nitrate is coupled with 2,4-xyleneol to form 6-nitro-2,4-xyleneol, which is estimated by GLC. Nitrite is distilled, oxidized to nitrate and estimated by the same method. Recoveries of 2-100 p.p.m. added nitrite and nitrate in Samsøe cheese were 80.6-98.9% and 96.5-99.7%, resp. [See FSTA (1978) 10 10P1408.] JMD

77

Separation of water-soluble reaction products of nitrite in cured meat.

Sebranek, J. G.; Cassens, R. G.; Greaser, M. L.; Hoekstra, W. G.; Sugiyama, H.

Journal of Food Science 43 (2) 638, 640 (1978)
 [15 ref. En] [Coll. of Agric. & Life Sci., Univ. of Wisconsin, Madison, Wisconsin 53706, USA]

A water-soluble extract was prepared from a cured meat product which had been manufactured with ^{15}N -labelled nitrite. Fractionation of this extract on Sephadex G-10 showed 1 large and 1 small peak of ^{15}N content, neither of which contained free nitrite (the large peak represented about 16% of the ^{15}N formulated as nitrite). The two ^{15}N containing peaks did not coincide with the ninhydrin positive or UV-absorbing fractions that were eluted. Examination of the labelled fractions for sulphhydryl groups also proved negative and inhibition of *Clostridium botulinum* was not accomplished by either of the fractions. IFT

78

Factors affecting panelists' perceptions of cured meat flavor.

Price, L. G.; Greene, B. E.

Journal of Food Science 43 (2) 319-322, 336
 (1978) [29 ref. En] [Dep. of Foods & Nutr., Univ. of Georgia, Athens, Georgia 30602, USA]

Several factors were tested for their ability to influence panelists' perceptions of flavour characteristics in cured meat. Factors found to influence panelists' judgments were score sheets, sample appearance and the co-presence of an oxidized or rancid flavour. Factors which did not affect panel scores significantly were type of product (i.e., ham vs. hot dogs vs. model system), internal processing temp. and amount of fat in samples. Evidence to date suggests that NaNO_2 may produce a stronger and more desirable cured product flavour but that curing without NaNO_2 would still produce a product that tasted 'cured' provided that NaCl was also included in the formulation. IFT

79

The relationship of added nitrate to pigment formation in native pork-sausage (longaniza).

Luis, E. S.; Lustre, A. O.; Lancel, C. H.

Food Chemistry 3 (1) 23-34 (1978) [35 ref. En]
 [Food Res. Dep., Ind. Res. Cent., Nat. Inst. of Sci. & Tech., Pedro Gil Street, Taft Avenue, Manila, Philippines]

A native pork sausage (longaniza) was prepared with 0, 50, 100, 300, 500, 2000, 3500 and 5000 p.p.m. NO_3^- curing salt; the NO_2^- , NO_3^- and nitrosomyoglobin concn. and sensory colour score were determined during 10 days storage at room temp. Results, shown graphically, revealed that colour formation started at once, reaching a max. on the 4th day. There was no significant difference between the colour score obtained with 50 or 500 p.p.m. NO_3^- , though it developed faster with higher levels. Residual NO_2^- and NO_3^- was proportional to the amounts added, though NO_2^- residues were negligible even after 500 p.p.m. (and NO_3^- was < 10 p.p.m. after 10 days). Higher additions (2000-5000 p.p.m.) posed a definite health hazard, as residual NO_2^- accumulated to > 300 p.p.m. RM

80

Effects of frozen storage and dry-curing on ham triglyceride fatty acids.

Kingsley, G. R.; Graham, P. P.; Young, R. W.

Journal of Food Science 43 (2) 479-482, 498
 (1978) [17 ref. En] [Dep. of Food Sci. & Tech., Virginia Polytechnic Inst. & State Univ., Blacksburg, Virginia 24061, USA]

Hams from 12 hogs of similar background were used to study long chain fatty acid levels. One ham from each hog was randomly assigned to be frozen and held at -27.8°C for 30 days prior to curing while the remaining ham from the pair was dry-cured. GLC analysis showed that both unfrozen and frozen hams were significantly higher in stearic acid and significantly lower in palmitic acid after ageing. Nonsignificant changes in other acids measured indicated that freezing did not affect fatty acid levels in the final product. Simulated dry-curing and ageing conditions for ham fat consisted of short time periods with elevated incubator temp. Freezing and curing treatments generally affected fatty acid levels in the simulated samples. The effect of nitrate was significant ($P < 0.05$) yielding lower concn. of palmitic and linoleic acids after ageing, than when nitrate was removed from the curing mix. IFT

81

[Determination of nitrates by automatic colorimetry after reduction by Devarda's alloy.]

Oliver, R.

Analusis 6 (3) 126-131 (1978) [7 ref. Fr, en]
 [CNRA, Bambey, Senegal]

It was shown that reduction of NO_3^- by Devarda's alloy (50% Al, 45% Cu, 5% Zn) is possible

in acid medium, thus permitting detn. of NH_4^+ and about 100 analyses/day by one operator. Optimal conditions for reduction were: 80°C with 0.5 ml conc. HCl for 10-15 ml reaction vol. Presence of K, Al, Ca and PO_4 ions had no effect on reduction of NO_3^- or colorimetric detn. of NH_4^+ . Mn and Fe ions slightly reduced the values for NH_4^+ . The limitations of the detn. were those of NH_4^+ detn., the reduction being complete and free from interference. Applications included NO_3^- detn. in vegetables. RM

82

Gas-liquid chromatographic determination of nitrate and nitrite in cheese, ham, fish sausage, cod roes, and salmon roes.

Toyoda, M.; Suzuki, H.; Ito, Y.; Iwaida, M.
Journal of the Association of Official Analytical Chemists 61 (3) 508-512 (1978) [8 ref. En]
[Nat. Inst. of Hygienic Sci., Osaka Branch, Hoenzaka, Higashi-ku, Osaka 540, Japan]

The 2,4-xyleneol method was modified and a GLC method was developed for nitrate and nitrite detn. in several foods. Either a flame ionization (FID) or an electron capture detector (ECD) can be used. Proteins and fats are removed from warm alkaline water with ZnSO_4 and the mixture is filtered. The filtrate is evaporated to dryness, redissolved in water, and reacted with 2,4-xyleneol in the presence of sulphuric acid to form 6-nitro-2,4-xyleneol. Interfering chlorides are precipitated with Ag_2SO_4 and the nitro-xyleneol is extracted with hexane, concentrated, and injected. Nitrite in the filtrate is distilled at pH 5, collected in alkaline solution, and dried. The residue is oxidized to nitrate with permanganate in the presence of sulphuric acid, and then chromatographed in the same manner as nitrate. Recoveries from several foods were 83-100% for nitrate and 80-100% for nitrite. The limit of sensitivity was 0.1 p.p.m. for both residues. AS

83

[Determination of some parameters in water. II. Sulphide. III. Nitrate. IV. Ammonia nitrogen.]
Campione, S.

Bollettino dei Chimici dei Laboratori Provinciali 4 (4) 80-86; 87-92; 93-99 (1978) [many ref. It, fr, en, de] [Lab. Chimico Provinciale di Bologna, Bologna, Italy]

The following simple and fast methods for analysis of natural, drinking and industrial waters are described: sulphide, based on formation of colloidal PbS and spectrophotometric detn. of the brown colour at 380 nm (concn. >0.02 mg/l.); nitrate, colorimetric detn., based on reaction between NO_3^- and sodium salicylates and spectrophotometric detn. of the yellow-compound at 420 nm, (concn. >0.5 mg/l. accuracy $\pm 3\%$); and ammonia N, based on the phenol-hypochlorite reaction, with formation of an indophenol and blue colour in alkaline medium in the presence of sodium nitroprusside and spectrophotometric detn. at 640 nm (concn. >0.05 mg/l., accuracy $\pm 5\%$). RM

84

Current research suggests the nitrate standard in drinking water is too low. [Review]

Parsons, M. L.

Journal of Environmental Health 40 (3) 140-142 (1977) [18 ref. En] [Arizona State Univ., Tempe, Arizona 72701, USA]

Current research on levels of nitrate in drinking water and food, and its effects on human health, are reviewed. The author concludes from the study that nitrates are consumed in large quantities regularly in foods, and that nitrate alone does not cause harmful effects, only in combination with bacteria, which are controlled in drinking water supplies. The author concludes that the drinking water standard for nitrate is inconsistent with the facts, and should be raised from 10 p.p.m. to ≥ 100 p.p.m. SP

85

Nitrates and nitrites in dried milk.

Gorner, F.; Hluchan, E.; Szokolay, A.; Antalikova, E.

XX International Dairy Congress E, 719 (1978) [6 ref. En] [Chem.-Tech. Fac. of SVST, Bratislava, Czechoslovakia]

All 36 samples of dried milk and dried milk products examined contained nitrate at >10 mg/kg, whilst nitrite was detected in 34 samples; the average contents were 23.5 and 1.0 mg/kg, resp. Reduction of nitrate to nitrite was observed during filtration of some samples after precipitation, due to bacteria, such as *Bacillus subtilis* and coliforms, resulting sometimes in very high nitrite concn. [See FSTA (1978) 10 10P1408.] FL

86

Relationship between the contents of nitrates and other components in milk.

Bielak, F.

XX International Dairy Congress E, 38-39 (1978) [En] [Inst. of Zootech., Krakow, Poland]

Increasing the quantity of nitrate-N in the fodder of 16 Polish Red-and-White cows resulted in an increase in the urea and nitrate-N contents of milk and in milk renneting time, while Ca and P contents and milk yields decreased. The adverse effect of nitrate-N in forage was alleviated by additional feeding of 4 kg dried sugar beet/day. [See FSTA (1978) 10 10P1408.] MEG

87

Content of nitrates and urea in milk of cows fed various concentrations of nitrate N in their rations.

Bielak, F.

XX International Dairy Congress E, 83 (1978) [En] [Inst. of Zootech., Krakow, Poland]

Feeding diets containing a high concn. of KNO_3 (100 or 300 mg nitrate-N/kg live wt.) increased the nitrate-N content in milk of 6 Polish Red cows from 10 to 114 and 167 $\mu\text{g}/100$ ml resp. 300 mg nitrate-N in the diet resulted in a small quantity of nitrites (<5 $\mu\text{g}/100$ ml) in the milk and significantly more urea and total protein (33.12 mg/100 ml and 3.49%) than

in control milk (23.7 mg/100 ml and 3.12%, resp.). [See FSTA (1978) 10 10P1408.] MEG

88

Composition and properties of milk from cows fed green forage cultivated with intensive nitrogen fertilization.

Leonhard-Kluz, I.; Bielak, F.; Zywezcok, H.
XX International Dairy Congress E, 74-75 (1978)
[En] [Inst. of Zootech., Krakow, Poland]

During consecutive 4- or 5-wk periods, 16 cows were fed green forage which had been fertilized with 240 kg N/ha (1st cut), 480 kg N/ha (2nd cut) and 720 kg N/ha (3rd cut). 8 of the cows also received 4 kg dried sugar beet. Increased N fertilization of the forage decreased daily milk yield, increased milk nitrate-N and urea contents, and extended milk renneting time. These adverse effects were reduced in supplemented cows. [See FSTA (1978) 10 10P1408.] MC

89

[Determination of nitrite in meat products.]

Dany Perez, D.

Husipar 27 (3) 131-134 (1978) [11 ref. Hu, en, de, ru] [Meat. Ind. Dep., Cuban Food Res. Inst., Carretera de Rancho Boyeros, Havana, Cuba]

Comparative studies were conducted on 5 procedures for detn. of nitrite in meat products: the AOAC method; the modified AOAC method of Nichols & Fox [FSTA (1973) 5 11S1356]; the ISO method; the Schall & Halcher method [Journal of the Association of Analytical Chemists (1968) 51, 4]; and the Ando & Nagata method (reference not given). Tables of results are given, comparing the mean values, % recovery values etc. for the various methods. It is concluded, on the basis of the results, that the modified AOAC method is the most suitable for detn. of nitrite in meat products, being simple and giving the most reliable results. [From En summ.]. AJDW

90

[Chemical changes during ripening of Spanish dry sausage (salchichon). II. Residual nitrite and pigment contents.]

Crespo, F. L.; Millan, R.

Archivos de Zootecnia 27 (105) 9-19 (1978) [30 ref. Es, en] [Catedra de Tecnologia y Bioquimica de los Alimentos, Fac. de Vet., Univ. de Cordoba, Cordoba, Spain]

Studies were conducted on changes in nitrite concn. and total pigment and nitrosopigment concn. in Spanish dry sausage (made with 120 p.p.m. NaNO₂ and 360 p.p.m. KNO₃) ripened for \leq 58 days. Tables and graphs of results are given. The results show that residual nitrite content was approx. 96.7 p.p.m. immediately after sausage manufacture, increased to 136.9 p.p.m. after the first approx. 9 days of ripening (as a result of nitrate decomposition) then decreased logarithmically to a level of approx. 26.8 p.p.m. at the end of the maturation period studied. Total

pigment concn. (total solids basis) did not change significantly during ripening; total pigment content (fresh wt. basis) tended to increase. nitrosopigment concn. (both total solids basis and fresh wt. basis) increased to a max. during the period 16-37 days of ripening, then decreased. Pigment conversion (nitrosation) % increased from an initial value of 11.8% to a max. of 56.4% after 9 days, then decreased slowly to 33.6% at the end of the ripening period studied. [See FSTA (1978) 10 8S1332 for part I, and following abstr. for part III.] AJDW

91

[Reactivity of sodium nitrite in porcine adipose tissue after sterilization.]

Cattaneo, P.; Cantoni, C.; Cipolla, M.

Industria Alimentari 17 (5) 400-402 (1978) [29 ref. It, en] [Istituto di Ispezione degli Alimenti di Origine Animale, Fac. di Med. Vet., Univ. di Milano, Milan, Italy]

Pork adipose tissue was homogenized, and filled into cans, which were sterilized at 112°C for 55 min. The samples contained NaNO₂ at concn. of 0 (control), 50, 100 or 150 p.p.m. Contents of free NO₂⁻, bound NO₂⁻ and NO₃⁻ in the fat and in the connective tissue (CT) were determined by the method of Olsman & van Leeuwen [see FSTA (1978) 10 1S10]. Concn. found at the 50, 100 and 150 p.p.m. levels of NaNO₂ addition were (ranges found): free NO₂⁻, 8.2-24% in fat and 49-50% in CT; bound NO₂⁻, 2-2.1% in fat and 5-7% in CT; and NO₃⁻ formed 6-10% in fat and 7-19% in CT; none was found in the control. The results are considered to confirm the formation of a bond between the nitrites and pork fat and CT. HBr

92

Enzymatic determination of nitrate: electrochemical detection after reduction with nitrate reductase and nitrite reductase.

Kiang, C.-H.; Kuan, S. S.; Guilbault, G. G.

Analytical Chemistry 50 (9) 1319-1322 (1978)

[19 ref. En] [Dep. of Chem., Univ. of New Orleans, New Orleans, Louisiana 70122, USA]

A method for the detn. of nitrate and/or nitrite using the dual enzyme system: MVH (methyl viologen, reduced form) nitrate reductase (EC 1.9.6.1.) and nitrite reductase (EC 1.6.6.4) has been developed. MVH-nitrate reductase was induced and purified from *E. coli* K12. MVH-nitrite reductase was isolated and purified from spinach leaves. Nitrate is reduced by MVH-nitrate reductase to nitrite which is subsequently reduced to NH₃ by MVH-nitrite reductase. The NH₃ produced is monitored, using an air-gap electrode. Nitrate and/or nitrite are determined in the range 5×10^{-5} to 1×10^{-2} M using either a soluble or an immobilized enzyme system. [This method should have application to analysis of foods and water.] AS

93

Enzymatic determination of nitrate: fluorometric detection after reduction with nitrate reductase.

Kiang, C.-H.; Kuan, S. S.; Guilbault, G. G. *Analytical Chemistry* 50 (9) 1323-1325 (1978) [7 ref. En] [Dep. of Chem., Univ. of New Orleans, New Orleans, Louisiana 70122, USA]

An enzymic method for the detn. of trace amounts of nitrate in water (including drinking water) has been developed. The enzyme, nicotinamide adenine dinucleotide (NADH)-dependent nitrate reductase (EC 1.6.6.1), has been induced from *Chlorella vulgaris* and was highly purified by affinity chromatography. Nitrate is reduced to nitrite by this enzyme in the presence of NADH as electron donor. At the same time, NADH is oxidized to NAD⁺. The rate of disappearance of NADH, indicated by a decrease of fluorescence intensity, is monitored with a newly developed, silicone-rubber pad fluorometric technique. Detection range is 50 parts/billion to 7.5 p.p.m. AS

94

Nitrite and nitrate are formed by endogenous synthesis in the human intestine.

Tannenbaum, S. R.; Fett, D.; Young, V. R.; Land, P. D.; Bruce, W. R.

Science, USA 200 (4349) 1487-1489 (1978) [30 ref. En] [Dep. of Nutr. & Food Sci., Massachusetts Inst. of Tech., Cambridge, USA]

Studies of nitrate balance in humans and analyses of faecal and ileostomy samples indicate that nitrite and nitrate are formed de novo in the intestine, possibly by heterotrophic nitrification. These findings significantly alter previous conceptions of human exposure to nitrite and suggest an even wider role for nitrite in the aetiology of human cancer. AS

95

Nitrates, nitrites and N-nitroso compounds. [Book] World Health Organization; United Nations Environment Programme

Environmental Health Criteria No. 5, 107pp. ISBN 92-4-154065-6 (1978) [many ref. En] [Geneva, Switzerland]

This vol. is based primarily on original publications and reviews, references to which are contained in the 500-item bibliography. Following a summary of the major issues and recommendations for further studies, the book reviews the chemical properties of nitrates, nitrites and N-nitroso compounds and methods of their analysis; their sources in nature and elsewhere; their transport cycle and transformation in food and other substances; their environmental levels and exposure of the population; and their metabolism. Effects of nitrates, nitrites and N-nitroso compounds are considered in both animals and man, and health risks to man of exposure to these substances are evaluated. Available data indicate that the current concn. of nitrates and nitrites in food and water do not constitute a direct health risk for adults or older

children, but there are risks, with possible fatal results, of high intakes of these substances in well water used for drinking or in making up infant foods and also in certain vegetables, for infants, particularly those ≤ 3 months of age. Attention is also drawn to the probable carcinogenic risk for man from exposure to N-nitroso compounds, most of which are mutagenic and some teratogenic in animal test systems. DMK

96

Nitrites in inoculated carrot juice as a function of nitrate content and temperature.

Hall, C. B.; Hicks, J. R.; Stall, R. E.

Journal of Food Science 42 (2) 549-550 (1977) [4 ref. En] [Vegetable Crops Dep., Univ. of Florida, Inst. of Food & Agric. Sci., Gainesville, Florida 32611, USA]

High levels of nitrite accumulated in fresh carrot juice inoculated with a nitrite-producing bacterium isolated from carrots when the juice nitrate levels were > 500 ppm. The rate of accumulation increased with temp. (20-35°C) over a 6-h period. Nitrite continued to increase in carrot juice at 4.5°C following incubation for 1-4 h at 30°C. IFT

97

Nitrates and nitrites in skim-milk and whey powders in the United Kingdom.

Harding, F.; Gregson, R.

XX International Dairy Congress E, 356-357 (1978) [1 ref. En] [Milk Marketing Board, Thames Ditton, Surrey, UK]

Nitrate/nitrite levels in dried skim-milk from 6 creameries were 0.45-3.06 µg/g (mean, 1.9) and in 12 dried wheys from 2 factories were < 0.5 -6 µg/g (mean, 2). Drying a skim-milk concentrate by a natural gas, direct fired drier or by an indirect drier (normally used) gave nitrate/nitrite concn. of 8 and 4 µg/g resp. [See FSTA (1978) 10 10P1408.] DMK

98

Bacon, sausage cures meet USDA Expert Panel recommendations.

Moore, K.

Food Product Development 12 (3) 72 (1978) [En]

B. Heller & Company, Chicago, have recently announced the availability of 2 new cures for bacon and sausage, which meet the USDA Expert Panel recommendations (120 p.p.m. ingoing nitrite for bacon, and 100 p.p.m. ingoing nitrite for cooked or fermented sausage; nitrate levels of 0 unless needed for organoleptic acceptance). Heller's Cure GB-0100 provides a pink, fine powder for use in sausages. It consists of salt, 4% NaNO₂, $\leq 2\%$ propylene glycol (anticaking agent) and 0.45 g FD&C Red No. 3/100 lb cure. When used at the recommended level, Cure 100 introduces 100 p.p.m. NaNO₂ into the meat. Specific application levels are given for emulsion type sausages and its use as a pickle cure. Heller's Cure 120 consists of

salt, sugar, 2.75% sodium erythorbate, 0.62% NaNO_2 , $\leq 2\%$ Na_2CO_3 , and $\leq 2\%$ propylene glycol. This white, fine powdered ingredient is designed for use in bacon products. VJG

99

The technology of sausage products in Germany. III. Büchwürstchen.

Reuter, H.

Fleischwirtschaft 58 (5) 733-736; 764, 767-768, 770 (1978) [11 ref. En, De] [Bundesanstalt für Fleischforschung, 8650 Kulmbach, Federal Republic of Germany]

This report describes the 10 subtypes of small size Brühwurst distinguished according to the German Guidelines for meat and meat products, and includes general remarks on Brühwurst production with advice to manufacturers on raw materials, additives and especially nitrite curing salt, preparation of the mixture, drying, reddening, smoking and scalding. 4 examples of recipes are given: Wiener, medium quality; Frankfurters, top quality; Regensburger, medium quality; and Bouillonwürstchen, medium quality. [See FSTA (1978) 10 11S1617 for part II.] RM

100

Causes of variation in botulinal inhibition in perishable canned cured meat.

Tompkin, R. B.; Christiansen, L. N.; Shaparis, A. B.

Applied and Environmental Microbiology 35 (5) 886-889 (1978) [6 ref. En] [Swift & Co., Res. & Development Cent., Oak Brook, Illinois 60521, USA]

Final internal processing temp. within the range 63-74°C did not alter the degree of botulinal inhibition in inoculated perishable canned comminuted cured pork subjected to abusive storage at 27°C. Adding haemoglobin to the formulation reduced residual nitrite after processing and decreased botulinal inhibition. Different meats yielded different rates of botulinal outgrowth when substituted for fresh pork ham. Pork or beef heart meat showed no inhibition of the *Clostridium botulinum* inoculum even with a 156- $\mu\text{m/g}$ amount of NaNO_2 added to the product. This effect appears to be one of stimulating outgrowth, since residual nitrite depletion was not measurably altered. AS

101

The effect of nitrate and nitrite on the microbial flora of Wiltshire bacon after maturation and vacuum-packed storage.

Shaw, B. G.; Harding, C. D.

Journal of Applied Bacteriology 45 (1) 39-47 (1978) [18 ref. En] [ARC Meat Res. Inst., Langford, Bristol BS18 7DY, UK]

Studies were conducted on unsmoked Wiltshire collar and back bacons cured with or without nitrate, and with various nitrite concn. (≤ 1980 p.p.m. NaNO_2) in the curing brine. The bacon

samples were vacuum-packaged, and stored for ≤ 6 days at 25°C, ≤ 19 days at 15°C or ≤ 35 days at 5°C. The pH, composition (NaCl , NaNO_2 , NaNO_3), odour and microbiological characteristics of the bacons were studied; tables of results are given. Micrococci, *Moraxella* spp. and *Moraxella*-like organisms predominated on back bacon after maturation (but before vacuum-packaging).

Differences between the floras of individual bacon samples were small, except in one study in which curing without nitrate gave much higher *Moraxella* counts than curing with nitrate. After vacuum-packaging, micrococci predominated on the fat, their count being increased by use of nitrate. After storage of vacuum-packaged back bacon, the lean had higher counts of lactic acid bacteria than the fat. Relative counts of micrococci and lactic acid bacteria were influenced by nitrate and nitrite levels and storage temp. Collar bacon contained no micrococci after vacuum-packed storage. Group D streptococci and aciduric lactobacilli predominated at 15°C; at 5°C, collar bacon cured with nitrate had a flora comprising mainly lactobacilli, whereas that cured without nitrate had a *Moraxella*-dominated microflora. Staphylococci were present, especially on the lean, on all bacons stored at 25°C, and, at low counts, on samples stored at 15°C. No staphylococci were found on samples stored at 5°C. Highest counts of lactic acid bacteria were present on the bacon cured with the lowest nitrite level (34 p.p.m.); it is suggested that nitrite may delay bacterial souring in vacuum-packaged bacon. AJDW

102

The fate of nitrite in meat curing and the determination of nitrosamines.

Woolford, G.

Dissertation Abstracts International, C 37 (1) 101 (1976) [En] [Univ. of Surrey, Guildford, Surrey, UK]

The metabolism of NaNO_2 by porcine skeletal muscle was investigated in vitro under conditions relevant to meat curing, i.e. at pH 6.0 under reducing (anaerobic) conditions with nitrite at 3mM (200 p.p.m.). Other concn. of nitrite were used to include the range relevant to curing and beyond. The rate of loss of nitrite from model cures was studied. In order to produce a 'balance sheet' the only stable N isotope, ^{15}N , was used as a tracer. Nitrite, labelled to 96.1% with ^{15}N , was found to be incorporated into both the non-water soluble fraction and the non-nitrite water-soluble fraction of the minced muscle cures. Analysis of the fractions revealed that enrichment was for the most part due to the formation of S-nitrosothiol derivatives and nitrosylmyoglobin. Analysis of the fractions also revealed the formation of nitrate and non-volatile N-nitrosamines, the latter in concn. ≤ 2 p.p.m. Total recovery of the ^{15}N label was 52-100%. Two methods of analysis of the ^{15}N were employed, MS and emission spectroscopy. Analysis of the headspace gases of the model cures by high resolution MS confirmed the formation of nitric

oxide. Volatile N-nitrosamines were unequivocally identified by the development of 2 methods, both involving the use of high resolution MS and gas chromatography, in samples of foodstuffs preserved with nitrite prepared both commercially and in the laboratory. AS

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FAB 48

NITRATES AND NITRITES IN MEAT PRODUCTS

SELECTED FROM VOLUME 11

FOOD SCIENCE AND TECHNOLOGY ABSTRACTS

under the direction of

Commonwealth Agricultural Bureaux, Farnham Royal, Bucks; Gesellschaft für Information und Dokumentation, Frankfurt am Main; Institute of Food Technologists, Chicago; Centrum voor Landbouwpublikaties en Landbouwdocumentatie (Pudoc), Wageningen.

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H. BROOKES
EDITOR

1

Infant methemoglobinemia and other health effects of nitrates in drinking water. [Lecture]

Shuval, H. I.; Gruener, M.

Progress in Water Technology 8 (4/5) 183-193 (1977)
[42 ref. En] [Environmental Health Lab., Hadassah Med. School, Hebrew Univ., Jerusalem, Israel]

Nitrates in water supplies in concn. >45 mg/l. (as NO_3) have led to numerous cases of infant methaemoglobinaemia, particularly in infants up to 6 months old, whose main liquid intake is dried milk formula made up with tap water containing high concn. of nitrates. Other possible negative health effects associated with the ingestion of nitrates in water for extended periods have been detected in animal studies, including changes in heart blood vessels, and behavioural effects. The possible association of nitrates in water with the formation of the potent carcinogens nitrosamines, is still to be determined. However, sufficient evidence is at present available to support strict adherence to the current nitrate drinking water standard of 45 p.p.m. [See FSTA (1979) 11 1H35.] AS

2

N-nitroso compounds, nitrite, and nitrate: possible implications for the causation of human cancer. [Lecture]

Mirvish, S. S.

Progress in Water Technology 8 (4/5) 195-207 (1977)
[many ref. En] [Eppley Inst. for Res. in Cancer, Univ. of Nebraska Med. Cent., Omaha, Nebraska 68105, USA]

The carcinogenicity of N-nitroso compounds (NNC), analysis of food for NNC, formation of NNC chemically, in vivo and by bacteria, and epidemiological studies are reviewed. [See FSTA (1979) 11 1H35.] AL

3

Statistical assessment of inorganic nitrogen in a small river system. [Lecture]

Porter, K. S.

Progress in Water Technology 8 (4/5) 253-274 (1977)
[7 ref. En] [Cornell Univ., Ithaca, New York 14853, USA]

Statistical assessment of nitrate levels in the River Lee, a tributary of the Thames, shows that concn. have almost doubled between 1968 and 1972 and are now very close to the WHO recommended limit of 11.3 mg N/l. for drinking water, so jeopardizing its use as a source of good quality drinking water. Variations in the levels of N in the River Lee and its dependence on factors, such as time and the population of the drainage basin, are described. Recorded concn. and calculated loads of inorganic N are related to inputs from various sources by linear regression to account for observed trends and variations in the N content. Trends indicate that by 1982 the concn. of inorganic N at Lea Valley Road observation point would exceed the WHO standard virtually throughout the yr. [See FSTA (1979) 11 1H35.] AL

4

Reduction of nitrate in a meat system by *Lactobacillus plantarum*.

Smith, J. L.; Palumbo, S. A.

Journal of Applied Bacteriology 45 (1) 153-155 (1978)

[11 ref. En] [Eastern Regional Res. Cent., Philadelphia, Pennsylvania 19118, USA]

Nitrate was reduced to nitrite in Difco Tryptic Nitrate medium by 4 of 6 strains of *L. plantarum*, by 3 *Lactobacillus* spp. and 2 *Leuconostoc* spp. Frozen starter cultures, Lactacel DS (*L. plantarum*) and Lactacel MC (*Pediococcus acidilactici* + *L. plantarum*) were also able to reduce nitrate in the Tryptic Nitrate medium, whereas Lactacel (*P. acidilactici*) did not. When Lactacel was used to inoculate a meat system (autoclaved beef ground to a paste) containing nitrate, only small amounts of cured-meat pigment were formed. Inoculation with Lactacel DS or Lactacel MC produced good cured meat colour due to the reduction of nitrate to nitrite by *L. plantarum*. MEG

5

Fate of *Clostridium botulinum* in perishable canned cured meat at abuse temperature.

Christiansen, L. N.; Tompkin, R. B.; Shaparis, A. B.

Journal of Food Protection 41 (5) 354-355 (1978) [2 ref. En] [Swift & Co., Res. & Development Cent., 1919 Swift Drive, Oak Brook, Illinois 60521, USA]

Perishable canned cured pork was prepared as follows: (i) with $156 \mu\text{g NaNO}_2/\text{g}$ and inoculated with $100 \text{ C. botulinum spores/g}$; (ii) $156 \mu\text{g NaNO}_2/\text{g}$, 10^4 spores/g; or (iii) $50 \mu\text{g NaNO}_2/\text{g}$, 100 spores/g. Cans were stored at 27°C and those of normal appearance were sampled at intervals. Contents of residual NaNO_2 , spores/g and spores + vegetative cells/g are tabulated for (i)-(iii). Competition occurred between rate of nitrite depletion and rate of death of germinated cells. Residual NaNO_2 declined to $<6 \mu\text{g/g}$ in 28 days for (i) and (ii) and 12 days for (iii). Spore counts were $<1/\text{g}$ in (i) after canning and declined as cells germinated; geometric mean of 5 counts at 43 days was 0.047 spores/g, 14.3 spores + vegetative cells/g (2 of 5 cans had $>10^3$ spores + cells/g). In (ii) spore counts decreased rapidly after canning from $4600/\text{g}$ at day 1 to $38/\text{g}$ after 10 days and $3.2/\text{g}$ after 28 days. Botulinal outgrowth occurred at $<20 \mu\text{g NaNO}_2/\text{g}$ (after 10 days); after 10 days 4 of 5 cans had <1000 cells/g and 1 had $>100\,000$ cells/g, after 43 days 3 of 5 cans had <1000 cells/g and 1 had $<100\,000$ cells/g. In (iii) botulinal outgrowth occurred at $13-26 \mu\text{g NaNO}_2/\text{g}$ (after 5 days) after geometric mean total viable botulinal count had decreased to $30/\text{g}$. DIH

6

Factors affecting the formation of nitrate from added nitrite in model systems and cured meat products.

Lee, S. H.; Cassens, R. G.; Winder, W. C.; Fennema, O. R.

Journal of Food Science 43 (3) 673-676 (1978) [18 ref. En] [Muscle Biol. Lab., Univ. of Wisconsin, Madison, Wisconsin 53706, USA]

Experiments were designed to determine the effect of the chemical state of myoglobin and presence of ascorbate on the conversion of nitrite to nitrate. In model systems, nitrate was not formed when nitrite was incubated in the presence of either metmyoglobin or ascorbate. However, most of the added nitrite was converted to nitrate when both ascorbate and metmyoglobin were present. It is suggested that ascorbate reduces metmyoglobin to myoglobin, and

then the myoglobin is oxidized simultaneously with nitrite to form nitrate. In cured meat products [pork muscles], a detectable level of nitrate was formed in the absence of ascorbate, but in the presence of ascorbate the level of nitrate formed was greater. The explanation suggested is that endogenous reductants in meat could play the same role as ascorbate in model systems. Such endogenous reductants were responsible for more than half of the nitrate formation in meat products containing sodium ascorbate. IFT

7

Effect of nitrite, storage temperature and time on *Clostridium botulinum* type A toxin formation in liver sausage.

Ala-Huikko, K.; Nurmi, E.; Pajulahti, H.; Raevuori, M. *European Journal of Applied Microbiology and Biotechnology* 4 (2) 145-149 (1977) [16 ref. En] [State Vet. Med. Inst., Hämeentie 57, 00550 Helsinki 55, Finland]

The occurrence of *Clostridium botulinum* type A toxin in inoculated, commercially processed Finnish liver sausages that were kept under different storage conditions was studied. 2 levels (0 and 100 mg/kg) of sodium nitrite addition, 3 different storage times (93, 6 and 14 days) and 3 temp. (15°, 20° and 25° C) were used. An addition of 100 mg of sodium nitrite/kg of sausage emulsion prevented toxin formation during a 2-wk period. In an inoculated sausage without nitrite the toxin was not produced when stored at 15° C, but was formed at 20 and 25° C. AS

8

Effect of potassium sorbate on toxinogenesis by *Clostridium botulinum* in bacon.

Ivey, F. J.; Shaver, K. J.; Christiansen, L. N.; Tompkin, R. B.

Journal of Food Protection 41 (8) 621-625 (1978) [13 ref. En] [Monsanto Co., 800 N. Lindbergh Boulevard, St. Louis, Missouri 63166, USA]

In an effort to reduce the initial levels of nitrite used to cure bacon and still supply the botulinal inhibition expected in cured meats, bacon was produced at nitrite levels of 0 and 40 p.p.m. NaNO_2 with and without 0.13 and 0.26% potassium sorbate. This bacon was inoculated with 1100 spores/g of a mixture of 5 Type A and 5 Type B strains of *Clostridium botulinum*. The time for occurrence of the first swollen package and number of toxic swells were recorded over 110 days of incubation at 27° C. The above variables were compared with bacon containing 80 and 120 p.p.m. NaNO_2 , as well as with a commercial sample. Presence of potassium sorbate in the cure significantly reduced the number of toxic swollen packages occurring during incubation and lengthened the time before a toxic swollen package was observed. The presence or absence of 40 p.p.m. NaNO_2 appeared to have no significant effect on the sorbate inhibition of *C. botulinum* in bacon in this study. Microbial growth of uninoculated samples was also retarded by addition of potassium sorbate to the brine. Flavour panel evaluations indicated that potassium sorbate decreased preference slightly using experienced judges. Also, reduced occurrence of nitrosopyrrolidine with lowered nitrite levels was observed. AS

9

Nitrites: focusing on safety.

Anon.

FDA Consumer 12 (1) 9-11 (1978) [En]

The US FDA and Department of Agriculture have asked food processors who use nitrites and nitrates to prove that these chemicals do not pose a hazard to consumers. Failure to do this will cause them to be prohibited, thus having a major impact on the bacon, ham and cured meat industries. Aspects discussed are: the use of nitrites and nitrates; their possible harmful effects; the problem of excessive use of nitrites; and the function of these chemicals. VJG

10

[Oxidation of nitric oxide using potassium permanganate.]

Kann, Yu. M.; Kalve, R. E.; Kass, A. Kh.

Tallinna Polütehnilise Instituudi Toimetised No. 402, 65-69 (1976) [8 ref. Ru, en]

With the aim of reducing the NO content of smoke used in food smoking (capable of giving rise to contamination with carcinogenic nitrosamines), oxidation of NO to NO_2 by potassium permanganate was studied in laboratory experiments. At NO concn. of 2.5-25 mg/m^3 , extent of oxidation was 80-95%. SKK

11

Sequential determination of nitrite, nitrate and total N-nitroso compounds without extraction.

Walters, C. L.; Hart, R. J.; Perse, S.

Abstracts of Papers, American Chemical Society 176, ENVR 208 (1978) [En] [British Food Manufacturing Ind. Res. Ass., Leatherhead, Surrey KT22 7RY, UK]

Nitric oxide can be determined with sensitivity and specificity through the chemiluminescent responses arising from its reaction with ozone which occur at the far end of the visible region and extend into the IR region. A procedure was devised in which N-nitroso compounds present on a freeze-dried matrix can be denitrosated in situ selectively to nitric oxide with HBr in glacial acetic acid, the gas being determined using a chemiluminescence analyser. The prior treatment of the matrix with acetic acid alone leads to the formation of nitric oxide from any nitrite or alkyl nitrite present, from which the contents of such compounds can be determined. Similarly, the addition of titanous chloride after the detn. of any N-nitroso compounds results in a further evolution of NO where NO_3^- is present. In the presence of other N compounds such as S-nitrosothiol, nitric oxide evolution occurs under the conditions of the test without the addition of any reagent. A small extent of irrelevant nitrosation can occur when dispersing nitric oxide from nitrite present but this can be prevented through the use of ascorbyl palmitate. The limits of detection of nitrite and nitrate by this procedure are of the order of 0.02 μg and 0.05 μg resp. whilst that of the non-volatile nitrosamine, N-nitrososarcosine, is approx. 0.7 μg . AS

12

[Nitrosamines. Formation, toxicity, and occurrence in foods.] Nitrosamine. Bildung, toxische Wirkung und Vorkommen in Lebensmitteln.

Bielig, H. J.; Askar, A.; Treptow, H.

Verbraucherdienst, B 22 (5) 101-103 (1977) [3 ref. De] [Inst. für Lebensmitteltech., Tech. Univ., Berlin]

Aspects discussed include: structure and carcinogenicity of nitrosamines; formation of nitrosamines by reaction of nitrites and amines in foods or in the stomach; occurrence of amines in foods; nitrates and nitrites as food additives (in meat products) and as natural constituents of vegetables and drinking water; occurrence of nitrosamines in foods; and detn. of nitrosamines. AJDW

13

[A food hygiene study on the formation of N-nitrosodimethylamine from trimethylamine-N-oxide and nitrite.]

Kunisaki, N.; Matsuura, H.; Hayashi, M.

Bulletin of the Japanese Society of Scientific Fisheries [Nihon Suisan Gakkai-shi] 43 (11)

1287-1292 (1977) [18 ref. Ja, en] [Kagawa Nutr. Coll., Komagome, Toshima-ku, Tokyo, Japan]

The formation of N-nitrosodimethylamine (NDMA) from trimethylamine-N-oxide (TMAO, which is a constituent of marine fishes) and nitrite (which is a permitted additive to meat and fish products) was studied both in vitro and with experimentally prepared fish sausages. In vitro, the amount of NDMA formed from TMAO and nitrite increased with decreasing pH of the reaction mixture, whereas that from dimethylamine and nitrite was optimal at pH 3.2-3.4. The formation of NDMA was also promoted by raising the ratio of nitrite to TMAO and the reaction temp. Fish sausages containing 800 mg TMAO/100 g and various concn. of nitrite from 50 to 2500 p.p.m. (as NO_2^-) at pH 6.5 were prepared in the laboratory and the amounts of NDMA formed in these fish sausages were measured. In the presence of 50-500 p.p.m. NO_2^- , no detectable NDMA was formed. However, approx. 0.9 p.p.m. NDMA was found in the sausage with 2500 p.p.m. NO_2^- . In connection with NDMA formation during the manufacture of fish sausages in Japan, the use of nitrite at permissible concn. of <50 p.p.m. as residual NO_2^- is acceptable from the food hygiene point of view. AS

14

Effect of polychlorinated biphenyls (PCB) and nitrite on vitamin A storage in rats. [Lecture]

Ikegami, S.; Nakamura, A.; Ono, S.; Nagayama, S.; Nishide, E.; Innami, S.

International Congress of Food Science & Technology - Abstracts p.93 (1978) [En] [Div. of Food Sci., Nat. Inst. of Nutr., Shinjuku-ku, Tokyo 162, Japan]

The effects on vitamin A storage in rats of combined feeding of PCB and nitrite were studied. Vitamin A concn. in rat liver was reduced when rats were fed a diet containing a combination of 3 p.p.m. PCB and 0.0105% NaNO_2 , the respective max. permitted safe levels in Japan. Cytochrome P-450 in rat liver was induced by this combination of PCB and NaNO_2 . The results suggest that combinations of chemicals found in foods may have biochemical effects even at levels found safe for each chemical alone. [See FSTA (1979) 11 2A60.] DIH

15

[Contents of nitrates and nitrites in vegetables.]

Kask, K. A.; Suurtkhal, A. A.; Kann, Yu. M.; Linnamyagi, A. Kh.; Mandel, V. A.; Mel'derkivi, A.-M. A. **Tallinna Polütehnilise Instituudi Toimetised** No. 402, 35-41 (1976) [14 ref. Ru, en]

The following mean values with ranges are given for NO_3 and NO_2 contents (mg/kg) resp. of samples of vegetables grown in Estonia and obtained during 1969-1973 from crops, stores and markets (numbers of samples in parentheses): beetroot (10), 2640 and 830-4730, and 46 and 0.1-360; lettuce (18), 2440 and 380-3110, and 2.7 and 0.1-5.6; garden radish (6), 2080 and 1300-3200, and 63 and 0.1-190; black radish (4), 1410 and 410-2380, and 5.4 and 0.5-11; swede (10), 1060 and 110-3760, and 14 and 0.3-36; rhubarb (6) 980 and 100-3380, and 12 and 0.1-26; pumpkin (6), 630 and 23-1380, and 3 and 1.0-11; cucumber (13), 480 and 32-1000, and 4.2 and 0.1-9.1; carrot (13), 390 and 90-760, and 2.7 and 0.1-5.6; and potato (10), 48 and 26-370, and 0.8 and 0.1-1.0. Data are also given on 'Nantaise' carrots, 'Bordeaux' beetroot and 'lygeva' cabbage grown experimentally during 1973-1975 under different conditions of fertilization. In general, contents of nitrates increased with increase in N fertilization, the effect being most marked in beetroot, in which nitrite contents also increased; carrot and cabbage showed only traces of nitrites. SKK

16

[Reduction of the nitrate content of carrots by various blanching methods.]

Mari, T.; Binder, I.

Hütöipar 25 (1) 7-9 (1978) [8 ref. Hu, en, ru] [Magyar Hütöipar Szekesfehervari Gyara, Raktar u. 1, Szekesfehervar, Hungary]

Comparative studies were conducted on methods for reduction of the moisture content of carrots; 1 cm x 1 cm x 1 cm carrot cubes were used in the experiments. Data are given for (i) raw samples, (ii) samples washed in water at 17° C, and samples blanched at (iii) 65°, (iv) 80° or (v) 95° C. Values for (i), (ii), (iii), (iv) and (v) samples were: nitrates, 339, 226, 187, 181 and 165 mg/kg; water-soluble DM, 8.8, 6.8, 6.6, 6.1 and 5.6%; total DM, 13.2, 9.1, 9.0, 8.4 and 8.3%; and β -carotene, 79.5, 72.7, 74.8, 84.0 and 93.6 mg/kg. AJDW

17

[Nitrate nitrogen content of brown rice by lowland, upland and upland polyethylene film mulching cultures.]

Taira, H.; Taira, H.; Furusawa, F.

Japanese Journal of Crop Science [Nihon Sakumotsu Gakkai Kiji] 46 (4) 510-515 (1977) [6 ref. Ja, en] [Nat. Food Res. Inst., Min. of Agric. & Forestry, Koto-ku, Tokyo 135, Japan]

The nitrate N content of nonglutinous and glutinous types of brown rice was investigated for lowland and upland polyethylene film mulching cultures of lowland rice and by upland and upland polyethylene film mulching cultures of lowland and lowland-upland

hybrid rices. Brown rice contained approx. 0.4–0.5 mg% nitrate N on a dry basis. However, the upland mulching culture gave higher nitrate N content in lowland brown rice than the lowland culture. The average increasing index, i.e. (upland mulching culture/lowland culture) \times 100, of non-glutinous type, glutinous type and both types of rice was 113.9, 108.0 and 112.3, resp. The upland mulching culture also gave higher nitrate N content in lowland and lowland-upland hybrid brown rices than the upland culture and the same manuring condition. The average increasing index, i.e. (upland mulching culture/upland culture) \times 100, was as follows: lowland brown rice: non-glutinous type 108.3, glutinous type 111.1 and both types 109.2; lowland-upland hybrid brown rice: non-glutinous type 112.8, glutinous type 106.0 and both types 109.0. AS

18

Nitrate, nitrite and N-nitrosamine contents of various types of Dutch cheese.

Stephany, R. W.; Elgersma, R. H. C.; Schuller, P. L. *Netherlands Milk and Dairy Journal* 32 (2) 143–148 (1978) [12 ref. En, nl] [Nat. Inst. of Public Health (RIV), Bilthoven, Netherlands]

17 Dutch cheeses (6 Gouda, 2 Gouda lunch-type, 4 Edam, 2 Baby Edam, 1 Edam loaf-type, 1 Frisian clove cheese and 1 Cheddar) were examined for volatile N-nitrosamines by combined gas chromatography/thermal energy analysis. 9 of the cheeses contained very low amounts of nitrosamines. Max. contents were: 0.15 μ g N-nitrosodimethylamine, 0.1 μ g N-nitrosodi-n-propylamine and 0.5 μ g N-nitrosomorpholine/kg, but because these levels are at the limit of detection by the methods used, some of the results may be false positives (especially the presence of N-nitrosomorpholine). Contents of nitrate and nitrite were below the max. set by Dutch cheese regulations. No correlation between the N-nitrosamine contents of cheeses and their nitrate or nitrite contents could be established. MEG

19

The role of nitrite in cured meat flavor.

Macdonald, B.; Gray, J. I.

Abstracts of Papers, American Chemical Society 176, AGFD 3 (1978) [En] [Dep. of Food Sci., Univ. of Guelph, Guelph, Ontario N1G 2W1, Canada]

Various hams were prepared using commercial curing procedures and contained 2.5% salt with varying levels of sodium nitrite, butylatedhydroxytoluene (BHT) or citric acid. Replicated panels, consisting of 10 selected members, evaluated the hams using a semi-structured scale for odour, flavour, overall palatability and colour. Analysis of variance on differences between each sample and an average control sample (R) containing 200 p.p.m. nitrite showed that panelists (P), treatments (TR), time (T), $P \times TR$, $P \times T$, and replicate $\times P \times T$ were significant at $\alpha = 0.05$. Panelists found that increasing levels of nitrite significantly reduced off-odour and off-flavour formation over a 14 day storage period ($\alpha = 0.05$). In addition, they were unable to detect any significant differences ($\alpha = 0.05$) between hams treated with

0.02% BHT and 100 p.p.m. citric acid. Panel results showed significant correlations with thiobarbituric acid values, Schiff base formation over a 7 day period, and colour difference values (ΔE). At specific time intervals, various carbonyl compounds were extracted and quantified to assess their contribution towards oxidized flavour. Results indicate that nitrite, BHT and citric acid function by retarding lipid oxidation in meat and have therefore led to additional studies to elucidate the mechanism of nitrite action in cured meat flavour. AS

20

Reaction of sodium nitrite with meat proteins.

[Lecture]

Cassens, R. G.; Ito, T.; Nakai, H.; Greaser, M. L. *International Congress of Food Science & Technology - Abstracts* p.96 (1978) [En] [Muscle Biol. Lab., Univ. of Wisconsin, Madison, Wisconsin, USA]

Studies were conducted to identify the form of protein-bound nitrite in meat products. Indolic N of tryptophan represents a reaction site; model system studies showed that with 10mM NaNO_2 and 1.0mM tryptophan the reaction forming the N-nitroso product was rapid at pH 4.0, but slow at pH 5.0. If native myosin (1 mg/ml) was reacted with NaNO_2 (10mM) at pH 6.0, formation of nitrosotryptophan was not detectable by spectrophotometry. Although further studies (at low pH) revealed reaction of nitrite with denatured myosin or lysozyme, it is concluded that conditions in cured meat are unfavourable for reaction of nitrite with tryptophan. [See FSTA (1979) 11 2A60.] AJDW

21

Nitrite as food additive: the pigmentation of cured meat. [Lecture]

Bonnett, R.; Charalambides, A. A.; Mahmoud, S. A.; Sales, K. D.; Scourides, P. A.

International Congress of Food Science & Technology - Abstracts p.96 (1978) [En] [Dep. of Chem., Queen Mary Coll. (Univ. of London), Mile End Road, London E1 4NS, UK]

The role of nitrite in development of cured meat colour and flavour and control of growth of undesirable bacteria (especially *Clostridium botulinum*) is discussed, together with nitrosamine formation. Electron spin resonance (ESR) studies on synthetic nitrosylprotohaem and on pigments in cured meat samples are discussed in detail. 2 ESR signals were detected in cured meat samples; one is attributed to a pentacoordinate nitrosylhaem complex, the other to a non-identified non-acetone-soluble component. It is suggested that cured meat pigmentation may be attributed to pentacoordinate nitrosylhaem embedded in, but not covalently bonded to a matrix of denatured globin. [See FSTA (1979) 11 2A60.] AJDW.

22

Pasteurization and sterilization of meat products.

[Lecture]

Jul, M.

International Congress of Food Science & Technology - Abstracts p.36 (1978) [En] [Danish Meat Products Lab., Howitzvej 13, 2000 Copenhagen F,

Denmark]

Aspects discussed include: plastics film-wrapped ready-to-serve and ready-to-eat refrigerated meat products; flavour defects in canned meats as a result of excessive heat treatment; retortable flexible packs; problems with proposed limitations on use of nitrites; and microbiological problems with vacuum-packaged sliced meat products made from meat cuts (e.g. hams) pasteurized in large cans. [See FSTA (1979) 11 2A60.] AJDW

23

[Nitrates and nitrites in meat processing.] [Lecture] Frouin, A.

Industries Alimentaires et Agricoles 95 (4) 285-294 (1978) [29 ref. Fr, en]

This review discusses the origin of and French legislation on the use of nitrates and nitrites for meat curing; the reduction of nitrates to nitrites; antibacterial, flavouring and colouring effects; health problems; nitrosation; nitrosamine formation; and amounts found in meat products. New aspects of these problems include the health effects of nitrates from plant products and water, chemical and analytical problems (standards, methods of detn.). The importance of optimal dosing and simultaneous addition of ascorbic acid to prevent oxidation is emphasized. RM

24

The use of nitrite and nitrate in bacon. [Lecture] Fried, I.

International Congress of Food Science & Technology - Abstracts p.94 (1978) [En] [Product Labels & Standards Div., USDA, Food Safety & Quality Service, Washington, USA]

The situation in respect of use of nitrite and nitrate in cured meat products in the USA is discussed, with reference to: nitrosamines; studies on bacon; forthcoming regulations; an update of data on nitrites, nitrates and nitrosamines in dry and cured meats and fermented sausage; and recommendations of the expert panel of the Secretary of Agriculture. [See FSTA (1979) 11 2A60.] AJDW

25

[Changes in nitrites and nitrates in Mortadellas. I. Colour formation.]

Parolari, G.; Baldini, P.; Pezzani, G.; Farina, G. *Industria Conserve* 53 (2) 81-85 (1978) [35 ref. It, de, en, fr] [Sta. Sperimentale per l'Ind. delle Conserve Alimentari, Parma, Italy]

The effects of NaNO_2 concn., ascorbic acid addition and storage conditions of the product on the chemical changes of added NO_2^- and NO_3^- and formation of NO-myoglobin (NO-Mb) in mortadella sausages were studied under industrial conditions. Mixtures were prepared with 20-150 mg NaNO_2/kg , with or without 0.2% ascorbic acid, sausages stored for ≤ 50 days at 0-3°, 18° or 30° C and subjected to chemical and microbiological analysis immediately and 1 day after cooking, after 7-40 days at 0-3° C, 15 days at 30° C and 21 days at 18° C. Tabulated results of sensory and spectrophotometric evaluation showed that NO_2^-

additions could be reduced to 40-60 p.p.m. without adverse effects on colour and flavour. Added ascorbate had no effect on colour, but reduced NO_2^- concn. to zero after 7 days at 0-3° C, NO_3^- concn. to zero after 30 days at 0-3° C. RM

26

Evidence for an Eh dependent nitrite reductase function in *S. typhimurium*.

Page, G. V.; Solberg, M.

Abstracts of the Annual Meeting of the American Society for Microbiology 78, 187 (1978) [En] [Rutgers Univ., New Brunswick, New Jersey 08903, USA]

Salmonellae are generally resistant to the inhibitory effects of NaNO_2 . Removal of the lipopolysaccharide (LPS) of *Salmonella typhimurium* by EDTA pretreatment did not result in the subsequent inhibition of growth by NaNO_2 indicating that LPS function is not to exclude NaNO_2 from the cell. The NaNO_2 disappeared from the medium while the cells were growing but after reaching the stationary phase no further losses were observed unless the pH was maintained at 7.3. Similar losses could be observed in a cell free system if the Eh of the medium was maintained between -250 to -175 mV. If the disrupted cell suspension was first heated in a boiling water bath for 15-18 min no NaNO_2 loss was observed regardless of the Eh. This study shows that *S. typhimurium* is capable of metabolizing NaNO_2 , apparently by means of a nitrite-reducing enzyme function which is redox controlled. AS

27

Determination of a non-volatile N-nitrosamine on a food matrix.

Walters, C. L.; Downes, M. J.; Edwards, M. W.; Smith, P. L. R.

Analyst 103 (1232) 1127-1133 (1978) [13 ref. En] [British Food Manufacturing Ind. Res. Ass., Randalls Road, Leatherhead, Surrey KT22 7RY, UK]

A method devised for the detn. of N-nitrososarcosine (NNS), in which the N-nitrosamine in solution is denitrosated with hydrogen bromide to form volatile products that are rapidly removed and determined in a chemiluminescence analyser, has been applied successfully to the same compound on powdered corn flakes. Differentiation of NNS and a number of other N-nitrosamines and N-nitrosamides from inorganic nitrite was achieved by decomposing the nitrite with acetic acid prior to the denitrosation of the N-nitroso compounds. In the presence of a secondary-amine receptor limited nitrosation can occur during the process of differentiation but this can be prevented through the use of ascorbyl palmitate. In differentiating between large amounts of nitrite and much lower levels of NNS on corn flakes, using a chemiluminescence analyser, the duration of the response from the nitrite can be shortened by freeze-drying the food matrix in the presence of ascorbic acid. The spectrophotometric detn. of NNS as nitrosyl bromide released into solution by the action of hydrogen bromide was hindered by the presence of powdered corn flakes. AS

28

Nitrate and nitrite in brewery fermentation. [Lecture] Weiner, J. P.; Ralph, D. J.; Taylor, L. *Proceedings, European Brewery Convention 15th Congress*, 565-579 (1975) [25 ref. En, de, fr] [Courage Ltd., London, UK]

Relatively high levels of nitrate (200 p.p.m.) had no effect on wort fermentation. Since brewing yeasts were unable to reduce nitrates to nitrites, the formation of nitrite during fermentation indicates that a bacterial contaminant is present. Some possible reactions of nitrites with beer constituents are discussed. [See FSTA (1979) 11 3H325.] MEG

29

[Studies on the accumulation of nitrate and nitrite in vegetables and fruits.]

Shin, K. S.; Namkung, S.

Korean Journal of Nutrition 10 (4) 299-303 (1977) [12 ref. Ko, en] [Dept. of Nutr., Seoul Health Junior Coll., Seoul, S. Korea]

Chinese radish and cabbage (mainly used for pickled vegetables in Korea [Kimchi]) showed the highest concn. of nitrate-N, some samples exceeding the recommended upper limit of 300 p.p.m. Spinach, lettuce, green onion and cabbage were relatively high while green pepper, bean sprout, parsley and fruits were very low. Nitrite-N was present in traces in all vegetables and fruits tested. Stems and roots of chinese radish and cabbage contained $\times 2$ more nitrate-N than leaves. KoSFoST

30

The role of nitrite in the production of canned cured meat products. [Review]

Lechowich, R. V.; Brown, W. L.; Deibel, R. H.; Somers, I. I.

Food Technology 32 (5) 45, 48, 50, 52, 56, 58 (1978) [52 ref. En] [Dep. of Food Sci. & Tech., Virginia Polytech. Inst., Blacksburg, Virginia 24061, USA]

This review is largely concerned with the role of nitrite and other factors in controlling *Clostridium botulinum* in canned cured meats. The following topics are discussed: the curing process; the bacteriological safety of canned cured meats; factors affecting this safety (the heating process, residual nitrite concn., NaCl concn., pH, storage temp. and the interrelationship of these factors); the incidence of Cl. botulinum in meat products; and Cl. botulinum spore germination, outgrowth and toxin production and their control in cured meats. JA

31

Factors affecting inhibition of *Clostridium botulinum* in cured meats.

Lee, S. H.; Cassens, R. G.; Sugiyama, H.

Journal of Food Science 43 (5) 1371-1374 (1978) [21 ref. En] [Food Res. Inst., Univ. of Wisconsin, 1805 Linden Drive, Madison, Wisconsin 53706, USA]

Ground pork trim was formulated with various levels of nitrite and one of 2 NaCl concn., canned and heated at 90°, 100° or 110° C. Cured meats were similarly prepared with meat whose sulphhydryls had been reacted with Ag⁺. Antibotulinum activity in these cured

products was tested by inoculating *Clostridium botulinum* spores directly into canned meats (96 spores/150 g) or into meat/buffer homogenates (1:1, w/v) adjusted to 30 p.p.m. NaNO₂ (48 spores/16.5 ml). Antibotulinum activity was detected by both challenges. It was greater in meats cured with higher nitrite concn., was lower if processing was at high temp. (110° vs. 90° C) and decreased during storage of the cured meats. Inhibitory activity was found in cured products made of Ag⁺-treated meats. IFT

32

Antibotulinal role of isoascorbate in cured meat.

Tompkin, R. B.; Christiansen, L. N.; Shaparis, A. B. *Journal of Food Science* 43 (5) 1368-1370 (1978) [22 ref. En] [Swift & Co., Res. & Dev. Cent., Oak Brook, Illinois 60521, USA]

The effect of antioxidants, reducing agents, and a chelating agent were tested in perishable canned cured meat. Isoascorbate, ascorbate, and cysteine enhance the antibotulinal effect of nitrite in perishable canned cured meat. It was determined that this effect was not due to the antioxidant or reducing properties which these compounds possess. The data indicate that they enhance the effect of nitrite by sequestering metal ion(s) in the meat. It is suggested that nitrite (nitric oxide) reacts with a cation-dependent material within the germinated botulinal cell and blocks a metabolic step which is essential for outgrowth. Enhancement of nitrite by isoascorbate, and similar compounds, may be due to preventing repair of damaged material or formation of new cation-dependent material. IFT

33

The role of nitrite in the production of canned-cured meat products. [Lecture]

Lechowich, R. V.; Brown, W. L.; Deibel, R. H.; Somers, I. I.

Proceedings of the Meat Industry Research Conference pp. 47-55 (1978) [25 ref. En] [Dep. of Food Sci. & Tech., Virginia Polytech. Inst. & State Univ., Blacksburg, Virginia, USA]

Aspects considered include: the need for nitrite for control of *Clostridium botulinum* in canned meat products; the heat treatment required for microbiological safety of cured meats (with reference to effects of nitrite and NaCl, initial bacterial counts, adverse effects of intensive heat treatment on the organoleptic properties, and energy costs); residual nitrite levels after processing; the importance of initial and residual nitrite concn. for microbiological stability of the product; and nitrosamines. [See FSTA (1979) 11 3G208.] AJDW

34

System for evaluating clostridial inhibition in cured meat products.

Robach, M. C.; Ivey, F. J.; Hickey, C. S.

Applied and Environmental Microbiology 36 (1) 210-211 (1978) [11 ref. En] [Monsanto Co., St Louis, Missouri 63166, USA]

A method for evaluating inhibition of *Clostridium botulinum*, *C. sporogenes*, and *C. perfringens* in cured

meat products was developed. This system can easily be employed in the microbiology laboratory, using Al ointment tubes as the product container, which enable swells caused by gas production by the organism to be readily observed. Results obtained confirmed earlier work on the inhibitory effect of sodium nitrite and sorbic acid against clostridia in cured meat products. AS

35

[Natural red colour development for each case.]
Kasper, M.

Revue de la Conserve Alimentation Moderne No. 63, 43-45, 47 (1978) [Fr]

Development of an attractive, stable red colour by reaction of nitrite with myoglobin in meat is discussed with reference to sausages, pork products, cooked hams, salted meats etc. It is emphasised that while nitrite may be produced by bacterial action in a salt plus saltpetre brine, it must be added directly except in pickling salt (defined in France as 99.4% NaCl + 0.6% NaNO₂). Poor colour development may not be due to faulty brine composition, but to processing errors. These include: use of incompletely thawed frozen meat; exposure to excessive temp., producing conversion of red myoglobin to oxymyoglobin and grey metmyoglobin, combined with albumen denaturation; excessive moisture content; unsuitable pH; air entrapment during mixing; use of previously salted and partly decolorized meat; and inadequate time for colour development. However, nitrosomyoglobin is not completely stable due to conversion of Fe²⁺ to Fe³⁺; the use of colour stabilizers to supplement nitrite is discussed for various products and conditions. Materials used are commonly ascorbic acid or ascorbates plus a carbohydrate (particularly glucose) which function as reducing agents. Ascorbic acid is also believed to hinder the formation of nitrosamines. ELC

36

Cheese - determination of nitrate and nitrite contents: method by cadmium reduction and photometry.

International Dairy Federation
IDF [International Dairy Federation] Standard 84:1978 6pp. (1978) [En] [Square Vergote 41, 1040 Brussels, Belgium]

This standard, which is also likely to be published as International Standard ISO/4099, specifies a method for determining nitrate and nitrite contents of hard, semi-hard, soft and processed cheeses. After extraction with warm water, precipitation of fat and proteins, and filtration, the nitrate in a portion of the filtrate is reduced to nitrite by means of copperized Cd. Sulphanilamide and N-1-naphthyl-ethylenediamine dihydrochloride are added to both the reduced and the unreduced portions of the filtrate, to develop a red colour which is measured photometrically at 538 nm wavelength. The original nitrite content and the total nitrite content after reduction of nitrate are calculated by comparison with standard sodium nitrite solutions; the nitrate content is calculated from the difference between the 2 values. Results of duplicate

determination must not differ by >3 mg/kg if the nitrate content is <30 mg/kg, or by >10% of the mean if the nitrate content is higher. ADL

37

[Effect of high concentration of nitrate nitrogen in the ration on chemical composition of blood and milk in cows.]

Bielak, F.

Roczniki Naukowe Zootechniki 5 (2) 187-198 (1978) [19 ref. Pl, en, ru] [Samodzielna Pracownia Mleczarstwa, Inst. Zootech., Aleksandrowice, Poland]

6 Polish Red cows in the 2nd-3rd months of lactation each received for 2 wk a common daily ration of 20 kg beet top silage, 4 kg meadow hay, 2 kg concentrates, 2 kg wheat bran, 1 kg dried sugar beet pulp, 100 g MM [? mineral] mixture and Na₂SO₄ at 0.1% of ration DM. During a 2-wk transition period, the cows were divided into 3 matched groups of 2, and progressively increasing doses of KNO₃ were added to ration concentrates of 2 groups. During the main 4-wk period, the 3 groups received 0, 200 or 300 mg nitrate N/kg body wt. In the final 10-day period, all 3 groups received the control ration. Contents in milk of total protein, fat, TS and SNF were determined daily, and contents of NO₃-N, NO₂-N, urea, Ca, P, Mg, Na and K, density, titratable acidity and renneting time were determined every 10 days. Mean values with variation coeff. and significance are tabulated for measurements in morning and evening milks of NO₃-N, total protein and urea, which showed significant differences between periods. Protein content increased significantly in all groups during the transition-final periods, the increases being most marked in the low supplemented group and least marked in the high supplemented group. Contents of NO₃-N and urea increased significantly in supplemented groups but not in controls. The treatments had no significant effect on milk yield, or on the other measured constituents or properties. No nitrites were detected in the milks, except for traces <5 µg NO₂-N/ml with the higher supplement. AJDW

38

[Varying the addition of saltpetre in the manufacture of different types of Danish cheese.]

Birkkjaer, H. E.; Thomsen, D.

Beretning fra Statens Forsøgsmejeri No. 230, 40pp. (1978) [6 ref. Da, en] [Statens Forsøgsmejeri, Hillerød, Denmark]

In Samso cheeses made with 0, 2, 5 and 10 g added KNO₃/100 l. milk, resp., nitrate (NO₃) content was 4-5, 9, 15-16 and 29 mg/kg in 24-h-old cheese and 7-10, 5, 4-6 and 3 mg/kg after 14 wk, while nitrite (NO₂) content was 0.4-1, 0.2, 0.8 and 1.1 mg/kg after 24 h and 0-0.1, 0, 0-0.3 and 0 mg/kg after 14 wk. Reduction of NO₃ to NO₂ appeared to be greatest during the 1st 2 wk of ripening, when NO₂ content in all cheeses rose to about 2-2.5 mg/kg. After the cheeses were moved from the warm ripening room (18° C) to the cold room (10° C), conversion of NO₂ to NO₃ became the dominant process, and NO₂ content fell rapidly. In Danbo cheeses made with 0, 2, 5 and 10 g added KNO₃/100 l. milk, resp., pH was 5.46, 5.52, 5.56 and 5.58 within 6 h after addition of starter, and 5.28, 5.3, 5.29 and 5.3 after 24 h. Texture

and flavour (after 15–16 wk) were better in cheeses made with 5–10 g KNO_3 than in those made with 0–2 g KNO_3 . Addition of KNO_3 to cheese milk accelerated coliform growth, probably because it inhibited acidification. It is concluded that moderate amounts of KNO_3 (≤ 10 g) must be added to ensure good cheese quality. Any regulations prescribing a max. content of 10 mg NO_3/kg ripened cheese would be unacceptable, as NO_3 contents of this magnitude were found in cheese made without KNO_3 . ADL

39

Ferrihaemochrome-forming nitrogenous bases as possible substitutes for nitrite in cured products.

Koizumi, C.; Maglalang, A. L. V.; Nonaka, J.
Bulletin of the Japanese Society of Scientific Fisheries [Nihon Suisan Gakkai-shi] 43 (4) 455–461 (1977) [9 ref. En] [Tokyo Univ. of Fisheries, Konan-4, Minato-ku, Tokyo, Japan]

To date, research on possible substitutes for nitrite in cured products has focused on ferrohaemochrome-forming ligands. Since such a restriction, however, was not deemed necessary, colour development through ferrihaemochrome formation was examined. 21 nitrogenous bases were tested for their ability to form ferrihaemochromes with haematin, metmyoglobin and urea-denatured myoglobin (Mb), in model systems at pH 6.0, 6.5, 7.0, and 8.0. Imidazole, histidylhistidine, carnosine, phenylalanine ethyl ester, tyrosine ethyl ester, and histidine methyl ester were found to be highly reactive to both haematin and denatured Mb, with imidazole the most reactive of all. The 2 histidyl peptides showed greater reactivities than histidine. In general, nitrogenous bases with a high degree of affinity for haematin also reacted well with denatured Mb. Based on these results, the possibility of using ferrihaemochrome-forming nitrogenous bases as nitrite substitutes in cured meat is discussed. AS

40

Determination of nitrite at low level without prior extraction.

Walters, C. L.; Downes, M. J.; Hart, R. J.; Perse, S.; Smith, P. L. R.
Zeitschrift für Lebensmittel-Untersuchung und -Forschung 167 (4) 229–232 (1978) [10 ref. En, de] [British Food Manufacturing Ind. Res. Ass., Leatherhead, Surrey, UK]

A method was devised for the detn. of nitrite at low level that is directly applicable to food or other dried matrices without prior extraction. NO released from nitrite through the action of acetic acid is determined using a chemiluminescence analyser. The limit of detection is approx. 0.02 μg , the coeff. of variation being 5.7 and 8.2% using 0.1 and 0.05 μg of NaNO_2 , resp. The chemiluminescence analyser response is diminished when > 0.5 ml water is present in the assay system (10 g sample + 0.1 ml acetic acid) unless HBr in acetic acid is used instead of acetic acid alone. The application of the method to the direct detn. of nitrite in freeze-dried cod fish indicated a content of 0.25 mg NaNO_2/kg , equivalent to 0.050 mg/kg of the original undried material. AS

41

[Detection of NH_3 , ascorbic acid, glucose, urea, nitrate, nitrite and sulphite in meat products.]

Nachweis von Ammoniak, Ascorbinsäure, Glukose, Harnstoff, Nitrat, Nitrit und Sulfit in Fleischerzeugnissen. [Lecture] Rietz, M.

Lebensmittelchemie und Gerichtliche Chemie 32 (5) 108–109 (1978) [De] [Staatliches Chem.-Untersuchungsamt, 3300 Braunschweig, Federal Republic of Germany]

A procedure for analysis of meat products for the substances listed in the title is described. A 10 g sample of the material under test is mixed with 2 ml saturated borax solution and 40 ml hot water, and held at 80° C for 15 min. After cooling, 2 ml each of Carrez I and Carrez II reagents are added. The mixture is then filtered. Ascorbic acid, nitrate, nitrite, sulphite and glucose are detected in the filtrate by means of Merckoquant or Merckognost test strips. For testing for NH_4^+ salts, 4 parts of the filtrate are mixed with 1 part of 10% NaOH. Urea is detected by the diacetylmonoxime method. [See FSTA (1979) 11 4G287.] AJDW

42

Comparison of sample preparation procedures for colorimetric analysis of nitrite in frankfurters.

Fiddler, R. N.; Fox, J. B., Jr.

Journal of the Association of Official Analytical Chemists 61 (5) 1063–1069 (1978) [17 ref. En] [USDA, E. Regional Res. Cent., Philadelphia, Pennsylvania 19118, USA]

3 groups of methods for analysing nitrite in meat are compared. All methods consist of a sequence of steps, grouped according to initial extraction procedures. In Group 1, the sample is treated with borate followed by HgCl_2 or Carrez I, and then Carrez II. In Group 2, the sample is diluted with water, heated at 80° C, and analysed immediately (AOAC) or after addition of either Na_2CO_3 and FeCl_3 or HgCl_2 . In Group 3, the sample is made alkaline with NH_4Cl buffer and then treated with 1 of the following: activated C + Carrez I and II, alumina cream, or $\text{AlK}(\text{SO}_4)_2$. At each step when the method involved the addition of a chemical, supernates and precipitates (if formed) were analysed for nitrite by Griess reagent both before and after AOAC digestion. The normally discarded precipitates formed after addition of HgCl_2 and Carrez I and II contained bound nitrite that could be detected by AOAC analysis. Except in the AOAC method, HgCl_2 improved nitrite analysis. Results by AOAC analysis were 3–300% higher than those determined after addition of any chemical or combination of chemicals. Spiked meat samples could not be used in comparing nitrite analysis methods because results were misleading. Acid meat samples, such as fermented sausages, required neutralization before AOAC analysis. AS

43

[Nitrites, ascorbic acid and the bacterial flora in canned meat.] [Lecture]

Cantoni, C.; Cipolla, M.; D'Aubert, S.

Rivista della Società Italiana di Scienza dell'Alimentazione 7 (2) 175-176 (1978) [It] [Istituto di Ispezione degli Alimenti di Origine Anim., Fac. di Med. Vet., Univ. degli Studi di Milano, Milan, Italy]

Samples of canned meat were prepared with or without 1000 mg sodium ascorbate/kg, and with 0, 5, 15, 25, 35, 45 or 55 mg NaNO_2 /kg. After sterilization and storage (conditions and duration not specified), the NO_2^- , NO_3^- , NO and ascorbate concn. and the incidence of bacterial contamination were studied. Tables of results are given. The results show that: considerable decomposition of NO_2^- occurs during sterilization; added ascorbate reduces the extent of NO_2^- decomposition; the max. residual NO_2^- concn. was 10.0 mg/kg; ≤ 20.5 mg NO_3^- /kg was formed, together with traces of NO; and concn. of ascorbate decreased during storage. Samples prepared with > 10 mg NaNO_2 /kg were sterile; those with lower NaNO_2 levels were contaminated with anaerobic bacteria, 10% of samples with 5 or 10 mg NaNO_2 /kg and 60% of samples without NaNO_2 being contaminated. [See FSTA (1979) 11 4G310.] AJDW

44

The breakdown into nitric oxide of compounds potentially derived from nitrite in a biological matrix.

Walters, C. L.; Hart, R. J.; Perse, S.

Zeitschrift für Lebensmittel-Untersuchung und -Forschung 167 (5) 315-319 (1978) [25 ref. En, de] [British Food Manufacturing Ind. Res. Ass., Leatherhead, Surrey, UK]

N-nitroso compounds can be determined using a chemiluminescence analyser by means of the NO liberated as a volatile product of their denitrosation using hydrogen bromide. Much of the nitrite present in or added to a food matrix can be lost even during storage in a refrigerated condition and thus the possibility arises of its conversion into compounds other than nitrosamines and nitrosamides which could also give rise to NO under, for instance, thermal degradation. Compounds potentially formed from nitrite that were studied in relation to their breakdown to NO included an alkyl nitrate, an alkyl nitrite, an amine oxide, an azoxy compound, a nitramine, a nitroguanidine, a nitrolic acid, a nitron, an oxime, a pseudonitrole, a pseudonitrosite, a thionitrite and a thionitrate as well as C-nitro and C-nitroso compounds. Only in the case of the nitrolic acid and the thionitrate was it likely that interference with the detn. of N-nitroso compounds could occur to any considerable extent. AS

45

[N fertilizers in relation to the environment.]

Stickstoffdüngung und Umwelt.

Kampe, W.

Verbraucherdienst, B 23 (5) 101-106 (1978) [8 ref. De] [Landwirtschaftliche Untersuchungs- & Forschungsanstalt, Speyer, Federal Republic of Germany]

Possible hazards resulting from excessive application of N fertilizers are discussed, with reference to: nitrate concn. in ground water and surface waters, and hence in drinking water; toxicity of nitrates; effects of N fertilization on the nitrate and nitrite contents of vegetables; and formation of nitrosamines by reactions involving nitrates and nitrites. AJDW

46

Comparison of the efficiencies of ascorbic acid and sulphamic acid as nitrite traps.

Williams, D. L. H.

Food and Cosmetics Toxicology 16 (4) 365-367 (1978) [8 ref. En] [Dep. of Chem., Univ. Sci. Lab., South Road, Durham DH1 3LE, UK]

The preferential rapid destruction of nitrite in the stomach by an added nitrite trap, such as ascorbic acid, would remove the nitrosamine cancer problem altogether. The efficiencies of various compounds used as nitrite traps were compared directly and quantitatively, using a kinetic method based on the denitrosation of nitrosamines in acid solution. Results are reported for both ascorbic acid and sulphamic acid under conditions in which (i) nitrosyl bromide or (ii) nitrosyl thiocyanate is the free nitrosating agent. For reaction via (i) both traps show the same reactivity, whereas for (ii) ascorbic acid is significantly more reactive, particularly at lower acidities. The results are discussed in terms of reaction mechanisms involving nitrosamine formation. VJG

47

Preservation of food. (In 'Radiation processing' [see FSTA (1979) 11 5G346].) [Lecture]

Diehl, J. F.

pp. 193-206 (1977) [33 ref. En] [Fed. Res. Cent. for Nutr., Karlsruhe, Federal Republic of Germany]

This report on world-wide developments in food irradiation covers irradiation (i) with a sterilizing dose (radappertization) of 3-5 Mrad, (ii) with a pasteurizing dose (radicidation or radurization) of 0.1-1 Mrad, and (iii) with a dose of ≤ 100 krad for insect disinfection. Using (i) it is hoped to obtain foods shelf-stable at ambient temp., though off-flavours have not yet been eliminated except by an expensive 4 step process (e.g. for sterile hospital diets). One important recommendation would be reduction of the nitrite content of foods sterilized in this way. (ii) is more effective than fumigation against salmonellae, trichinae and tapeworms, can increase storage time and also has the advantage of being usable on frozen or packaged foods, particularly meat and dairy products, and for spices and enzyme preparations. (iii) has been used to disinfest cereals, and fresh and dried fruits, but is less lasting than chemical treatments. It is suitable for packaged flour and has possible application to plants (e.g. mangoes) whose movement is often restricted for fear of pests. Irradiation can also inhibit the sprouting of potatoes (≤ 10 krad) and delay the ripening of bananas and similar fruits (10-100 krad). It is increasingly being used for feeds for laboratory animals and can serve to sterilize food packaging materials. Costs, legal aspects in various countries and future developments are discussed. It is recommended that irradiation be considered as a treatment rather than as an "additive", as is the case at present. KME

48

[Effects of fertilizer level on the nitrate and nitrite content of vegetables.]

Vidacs, G.; Todor, L.; Zelenak, M.

Élelmezési Ipar 32 (8) 298-301 (1978) [7 ref. Hu, en, de, ru] [Konzerv- és Paprikaipari Kutató Intézet, Földvári út 4, 1097 Budapest, Hungary]

Effects of N fertilizers on the nitrate content of leaf vegetables (especially spinach) are discussed, together with the danger of the formation of toxic levels of nitrite, and the potential for reduction of nitrate levels by processing. Tables and block diagrams of data are given showing: nitrate levels in spinach in relation to permissible levels for consumption by adults and by children; effects of N level applied on nitrate concn. in spinach; effects of blanching, conversion to a puree and sterilization on nitrate levels in spinach; and nitrite formation in spinach puree. AJDW

49

[Nitrate and nitrite contents of dried milk products.]

Der Nitrat- und Nitritgehalt getrockneter Milchprodukte.

Görner, F.; Hluchan, E.; Antalík, E.

Deutsche Molkerei-Zeitung 99 (45) 1584-1586, 1588 (1978) [29 ref. De] [Inst. for Tech., Microbiol. & Biochem., Tech. Univ., Bratislava, Czechoslovakia]

Nitrate contents of 31 infant foods, 5 dried milks and 9 whey powders analysed averaged 23.5 (16-46), 25.8 (14-36) and 333 (150-590) mg/kg and their nitrite contents 1.0 (0.0-2.1), 1.1 (0.9-1.6) and, excluding 2 exceptionally high values, 0.4 (0.0-1.2) mg/kg resp. Nitrate contents of infant foods and dried milks were consistent with those already recorded for milk, but nitrite contents appeared to be unacceptably high in infant foods; for these a max. of 0.01 mg/kg is recommended. The possibility of the nitrite content of infant foods increasing by microbial reduction of nitrate during the refrigeration stage of the parent milk or whey or of the reconstituted product is pointed out. GTP

50

[Nitrite substitutes. I. Behaviour of complex nitro- and nitrosyl-compounds in meat products.]

Ersatzstoffe für Nitrit. I. Verhalten komplexer Nitro- und Nitrosylverbindungen in Fleischwaren.

Mirna, A.; Coretti, K.

Fleischwirtschaft 58 (9) 1526-1528; 1445 (1978) [21 ref. De, en] [Bundesanstalt für Fleischforschung, 8650 Kulmbach, Federal Republic of Germany]

Complex nitro- and nitrosyl-compounds were examined as possible substitutes for NO_2^- in 'Brühwurst' and dry sausages. Sodium pentacyanonitrosyl ferrate (III) (i.e. sodium nitroprusside) was found to be a suitable NO_2^- substitute for reddening of these products, when used in a 0.5% mixture with NaCl (equivalent to NO_2^- curing salt with 0.12% NaNO_2). Culture experiments showed sodium nitroprusside to be more effective than NaNO_2 against Clostridia. AS

51

[Quick determination of nitrite in meat products.

I. Analysis of raw and cooked ham, Kochwurst and Brühwurst products.] Schnellbestimmung von Nitrit in Fleischwaren. I. Untersuchungen an Roh- und Kochschinken, Koch- und Brühwurstzeugnissen. Honikel, K. O.; Egginger, R.

Fleischwirtschaft 58 (9) 1523-1525; 1445 (1978) [3 ref. De, en] [Bundesanstalt für Fleischforschung, 8650 Kulmbach, Federal Republic of Germany]

A method is described for detn. of NO_2^- in meat products quickly and with sufficient accuracy for exploratory purposes. The Aquaquant No.14408 developed by Merck (Darmstadt, Federal Republic of Germany), for water analysis was modified for uncooked meat, and, 'Kochwurst' and 'Brühwurst' sausages. NaNO_2 content was determined by formation of a red azo dye with Griess's reagent (sulphanilic acid and α -naphthylamine in acid solution), and matching the colour intensity with a colour card graded for NO_2^- concn. A regression line constructed with the results of conventional NO_2^- detn. gave a correlation coeff. of $r = 0.98$. The method was not suitable for 'Rohwurst' (dry sausages, containing a coarsely minced heterogeneous mixture of meat and fat). RM

52

Significance of the reaction of nitrite with tryptophan.

Nakai, H.; Cassens, R. G.; Greaser, M. L.; Woolford, G. *Journal of Food Science* 43 (6) 1857-1860 (1978) [18 ref. En] [Muscle Biol. Lab., Univ. of Wisconsin, 1805 Linden Drive, Madison, Wisconsin 53706, USA]

The reaction of NaNO_2 with tryptophan was studied spectrophotometrically; the N-nitroso reaction product had an absorption peak at 330 nm and the absorption max. of tryptophan was shifted from 277 nm to 266 nm. In model systems, where NaNO_2 was 10mM and tryptophan was 1.0mM, the reaction proceeded rapidly at pH 4.0 and very slowly at \geq pH 5.5. Experiments with acetyltryptophan and dipeptides showed that if the primary amino group of tryptophan was blocked, then nitrosation of the indole N was promoted. Tryptophan was formed when the N-nitroso reaction product was subjected to gel filtration in the absence of nitrite. If the concn. of reactants and pH are compared in model systems favourable for formation of nitrosotryptophan and in cured meats, it is apparent that the environment for nitrosation of tryptophan is unfavourable in most cured meats. IFT

53

Effect of sorbic acid and sodium nitrite on Clostridium botulinum outgrowth and toxin production in canned comminuted pork.

Ivey, F. J.; Robach, M. C.

Journal of Food Science 43 (6) 1782-1785 (1978) [6 ref. En] [Monsanto Co., 800 N. Lindbergh Boulevard, St. Louis, Missouri 63166, USA]

Experiments to determine the effect of sorbic acid alone and in combination with low nitrite and phosphate on botulinal toxin production in inoculated perishable, canned, comminuted, cured pork were

conducted. 48 test lots of product were inoculated with approx. 100 spores/g of a mixture of 10 strains each of type A and B *Clostridium botulinum*. 25 cans of each test lot were incubated at 27° C for ≤ 110 days. The time of swelling was recorded for each can and the first 10 swells/test lot were tested for toxin. Multiple regression analysis of the time to first swell showed nitrite concn. had a significant linear effect on delaying outgrowth and toxin production of *C. botulinum*. Sorbic acid concn. was also significantly related to inhibition but through the 4th power of sorbic acid concn. The use of either sodium acid pyrophosphate or sodium hexametaphosphate was synergistic with sorbic acid as indicated by their statistically significant positive interactions. Several test lots containing 0.2% sorbic acid and either phosphate had no toxic swells after 110 days of incubation with or without 50 p.p.m. NaNO_2 . These data indicate that sorbic acid may be a potential alternative preservative to high levels of nitrite in canned, comminuted pork products. IFT

54

Improved colorimetric method for determining nitrate and nitrite in foods.

Sen, N. P.; Donaldson, B.

Journal of the Association of Official Analytical Chemists 61 (6) 1389-1394 (1978) [20 ref. En] [Health Protection Branch, Food Res. Div., Health & Welfare Canada, Ottawa, Ontario Canada K1A 0L2]

A method is described for determining nitrate and nitrite in cured meat products, cheeses, and vegetables. The nitrite is determined colorimetrically by diazotization of sulphanilic acid and subsequent coupling with N-(1-naphthyl)-ethylenediamine. The concn. of nitrate + nitrite is determined similarly but after reduction of the nitrate to nitrite on a Cd column. The difference of the 2 values is a measure of the nitrate concn. The main improvements are replacing the Griess reagent, which contains a carcinogen, with a mixture of sulphanilic acid and N-(1-naphthyl)-ethylenediamine, providing for adjustment of pH of the sample suspension during extraction and digestion by heating, and maintaining constant pH by controlled addition of buffers and acids during colour development. The method was successfully applied to the analysis of 15 samples of meat products, 23 cheeses, and 6 different vegetables. The average recovery of NaNO_2 added at levels ranging from 10 to 30 p.p.m. was 95% and recovery of NaNO_2 added at levels from 30 to 400 p.p.m. was 94% (corrected for Cd column efficiency). AS

55

Naturally occurring toxicants in foods. [Lecture]

Stoewsand, G. S.

Special Report, New York State Agricultural Experiment Station No. 26, 14-16 (1977) [En] [Dep. of Food Sci. & Tech., New York State Agric. Exp. Sta., Cornell Univ., Geneva, New York, USA]

The following 6 natural food toxicants are selected for brief discussion: toxic amines (e.g. serotonin, 5-hydroxytryptamine), which are found especially in fermented foods; cyanogenetic glycosides (e.g. amygdalin from apricot kernels); hallucinogens, the

most important of which is myristicin from nutmeg, but also including mushrooms hallucinogens; nitrites, which may produce methaemoglobinaemia and are found at high levels in highly fertilized beets and spinach; oxalates, which chelate Ca making it unavailable for absorption; and glucosinolates, or thioglucosides, components of Cruciferae which are enzymically converted to goitrogenic isothiocyanates. JRR

56

[Effect of nitrates on tinplate corrosion.]

Marsal, P.

Bulletin, Centre de Recherches du Fer-Blanc pp. 14-24, 3 (1977) [16 ref. Fr, en, de, es] [Cent. de Recherches du Fer-Blanc, 57103 Thionville, France]

This review-type article is largely based on literature data illustrated by tabular and graphic material. Results of tests carried out in the author's laboratory, particularly those reported by Rocquet & Marsal [Effet des nitrates sur la corrosion interieure des boites en fer-blanc, Comite International Permanent de la Conserve (Nov. 1966); Paris] on tin-coating removal from cans containing diluted grapefruit juice, Mirabelle plums in syrup, French beans or tomato pulp, all with none or graded amounts of added nitrate are graphically presented. The article also covers source of nitrates in canned foods; mechanism of nitrate corrosion; main characteristics of nitrate action derived from tests with model solutions; and tests with canned foods. The main conclusions are that nitrates have a marked accelerating effect on tin-coating removal, particularly in cans containing acid foods, and that only adequately lacquered cans offer a practical solution to the problem, though Fe migration into the can contents may thereby be increased. SKK

57

Nitrate removal from water supplies by ion exchange: resin selectivity and multicomponent, chromatographic column behavior of sulfate, nitrate, chloride and bicarbonate.

Clifford, D. A.

Dissertation Abstracts International, B 37 (10) 5244: Order No. 77-7893 (1977) [En] [Univ. of Michigan, Ann Arbor, Michigan 48104, USA]

In connection with the development of a new ion exchange method for removing nitrate from water, suitable for use in non-arid/non-coastal locations, studies were made of (i) the anion resin characteristics associated with high nitrate selectivity in the presence of sulphate, chloride and bicarbonate and (ii) the column elution behaviour of these anions as a function of process variables (resin type, fluid detention time, raw water composition). The new method utilizes strong-acid cation and weak-base anion exchangers with bypass blending of raw water and regeneration with HNO_3 and NH_4OH . Study (i) indicated the resin selectivity sequence to be sulphate > nitrate > chloride > bicarbonate. Study (ii) indicated that process efficiency is influenced by nitrate/chloride selectivity, equivalent fraction and fluid detention time. JA

58

The effect of curing salts on the growth of *Clostridium perfringens* (welchii) in a laboratory medium.

Roberts, T. A.; Derrick, C. M.

Journal of Food Technology 13 (4) 349-353 (1978) [15 ref. En] [Meat Res. Inst., Langford, Bristol BS18 7DY, UK]

The tolerance of *C. perfringens* strains isolated from (i) bacon, (ii) mud and (iii) food poisoning cases to NaCl (3-7%) or NaCl (3-6%) + NaNO₂ (0-300 µg/ml) solutions was compared to that of culture collection strains. 5 of 12 (iii) strains and 4 of 4 (i) strains grew in 6% NaCl (vs. 1 of 3 culture collection strains) and only 1 (iii) strain grew in 7% NaCl. It was concluded that all strains showed the same order of resistance, as was the case for NaCl + NaNO₂ solutions. NaCl concn. required to inhibit growth of 10 representative strains at 300, 200 or 50 µg NaNO₂/ml were 3%, 4% and 5%, resp. (Incubations were at 35° C for at least 2 months in broth cultures.) Recent trends to reduction in salt and nitrite contents of cured meat products are concluded to be likely to increase possible *C. perfringens* growth in these products if stored under inadequate refrigeration. DIH

59

[Colour and colour changes in meat products.]

Nordal, J.; Slinde, E.

NINF Informasjon No. 4, 15-23 (1978) [No]

The role of the various forms of globin in the natural colouring of meat and changes occurring in it is outlined, and the effect of nitrite addition on colour development is discussed, with particular reference to practical utilization of the nitrite in meat products. HBr

60

Factors affecting corrosivity. I. Electrochemical studies.

Jewell, K.

Technical Memorandum, Campden Food Preservation Research Association No. 206, 11pp. (1978) [2 ref. En]

The report describes preliminary experiments on the development of a method which will ultimately be used for rapid screening of many compounds for their ability to inhibit nitrate-induced corrosion of tinplate. The object is to find a practical inhibitor which can be included in canned foods. AS

61

Factors affecting corrosivity. II. Storage studies.

Blundstone, H. A. W.

Technical Memorandum, Campden Food Preservation Research Association No. 207, 31pp. (1978) [8 ref. En]

The effects of headspace size, O₂ level and inhibitor (allylthiourea) on nitrate corrosion in a citrate buffer solution were investigated. Tests had previously been carried out in model system cells, and this experiment was made using conventional tinplate cans containing similar solutions. The level of NO₃⁻ studied was 125 p.p.m. The results agreed well with the cell studies,

and inter-can variation for each variable was much smaller than expected. Results showed that low headspace O₂ levels reduced tin corrosion, but low headspace vol. only reduced corrosion in the absence of NO₃⁻ or in the presence of an NO₃⁻ inhibitor.

Allylthiourea (12.5 p.p.m.) proved to be a powerful inhibitor of NO₃⁻ induced corrosion but tended to accelerate corrosion of Fe. [See preceding abstr. for part I.] AS

62

A review of the nitrate problem.

Nicolson, N. J.

Chemistry and Industry No. 6, 189-195 (1979) [12 ref. En] [Thames Water Authority, Reading Bridge House, Reading, RG1 8PR, UK]

Trends in NO₃ concn. and NO₃ loads are discussed with reference to sources (surface waters, groundwater) and different methods of reducing the load (blending, storage, direct treatment and provision of low-NO₃ bottled water for infants.) The WHO recommended level for Europe is ≤ 50 mg NO₃/l. (equivalent to 11.3 mg N/l.), but quotes 50-100 mg NO₃/l. as 'acceptable'. HBr

63

Nitrates in drinking water and the early onset of hypertension.

Malberg, J. W.; Savage, E. P.; Osteryoung, J.

Environmental Pollution 15 (2) 155-160 (1978) [9 ref. En] [Colorado Epidemiologic Pesticide Studies Cent., Colorado State Univ., Spruce Hall, Fort Collins, Colorado 80523, USA]

During 1969-1974, the possible relationship between nitrate levels in drinking water and incidence of hypertension was studied in 18 communities of Weld County, Colorado, USA. The 9 communities with zero nitrates in the drinking water (control) had a higher incidence of primary and secondary hypertension than the 9 communities receiving water with 19-125 p.p.m. nitrates (7.9 vs. 5.9/1000 population) but that onset was considerably later (peak at 70-79 vs. 50-59 yr of age). HBr

64

[Effect of fertilization on quality-determining N-constituents.] Abhängigkeit qualitätsbeeinflussender pflanzlicher N-haltiger Inhaltsstoffe von der Düngungsintensität.

Dressel, J.

Landwirtschaftliche Forschung Sonderheft 33/II, 326-334 (1977) [35 ref. De, en, fr] [BASF AG, Postfach 220, D-6703 Limburgerhof, Federal Republic of Germany]

Effect of N-fertilization on nitrosamines in vegetable products was investigated. Tabulated results showed that while application of 120 kg N/ha considerably increased the NO₃ concn. (e.g. from 103 to 450 p.p.m. in fresh wt. of spinach, and from 19 to 263 p.p.m. in lettuce), it did not lead to nitrosamine formation in the plants. RM

65

[Influence of heat treatment of spinach at temperatures from 100° to 130°C on major constituents. III. Changes in contents of minerals, protein, nitrate and oxalic acid.] Der Einfluss thermischer Behandlung von Spinat im Temperaturbereich zwischen 105 und 130°C auf den Gehalt an wesentlichen Inhaltsstoffen. III. Veränderungen von Mineralstoff-, Protein-, Nitrat- und Oxalsäuregehalt. Heintze, K.; Zohm, H.; Fricker, A.; Paulus, K. *Lebensmittel-Wissenschaft und -Technologie* 11 (6) 301-305 (1978) [5 ref. De, en] [Inst. für Lebensmittelchem. der Bundesforschungsanstalt für Ernährung, D-7500 Karlsruhe, Federal Republic of Germany]

The influence of thermal treatment at 105-130°C for 1-6 min on the contents of Na⁺, K⁺, Mg²⁺, Ca²⁺, oxalic acid, crude protein and pure protein of spinach was determined and compared with results obtained in the temp. range 70-100°C (0.5-16 min). With the soluble components, e.g. various minerals, the thermal treatment caused substantial losses. The differences observed could be correlated with known properties of these substances. Of the alkaline and alkaline-earth metals investigated, the extent to which these substances were leached out was Na > K > Mg; Ca, on the other hand, was taken up from the relatively hard water used for the investigations. Depending on the intensity of the thermal treatment, nitrate, which is readily soluble in water, also disappeared from the test material; max. losses were as high as 80%. A variable picture was obtained with components only partially accessible to leaching. Oxalic acid disappeared only to a certain extent from the spinach; max. losses are about 30%, related to the absolute content of the raw material. Raw, and particularly pure protein are practically insoluble in water; any changes can therefore be regarded as directly caused by the influence of heat. Regarding raw protein, there were indications only in the temp. range 120-130°C that such temp. in combination with longer treatment times may lead to a change in the protein fraction, which became partly soluble in water. The different reactions of the components investigated in these studies underline the necessity of fixing the limits of acceptable changes, depending on the purpose of the thermal treatment, as the basis for an optimization of the process. [See preceding abstr. for part II.] AS

66

[Contamination of cereals during direct drying.] Kontamination von Getreide durch Schadstoffe bei der direkten Trocknung. Hutt, W.; Winkler, E. *Getreide, Mehl und Brot* 32 (10) 260-263 (1978) [21 ref. De] [Inst. für Agrartechn., Univ. Hohenheim, Garbenstrasse 9, 7000 Stuttgart 70, Federal Republic of Germany]

The possibilities of contamination of cereal grains dried in the conventional type of direct-drying system heated by oil or gas are considered. Cereals may accumulate deposits containing inorganic as well as organic constituents resulting from direct contact with partial or complete fuel combustion products. Experiments were performed in which maize, wheat or

barley were dried in direct and indirect drying systems and the level of surface contamination with nitrates and polycyclic aromatic hydrocarbons (PAHs) was determined by analysis. Results are presented, indicating that there was a negligible increase in nitrate content due to direct heating methods, while slight increases in the content of PAHs could be detected in some instances, mainly as a result of incomplete combustion due to malfunctioning of the oil burner or incorrect adjustment of the fuel/air ratio. BDH

67

[Gas chromatographic determination of nitrate in sweetened milks by xlenol method.] Cantafora, A.; Palomba-Martire, A.; Monacelli, R. *Rivista della Societa Italiana di Scienza dell'Alimentazione* 7 (2) 117-122 (1978) [5 ref. It, en] [Istituto Superiore di Sanita, Rome, Italy]

Condensed milk and milk-based infant feeds were analysed for nitrate by the 2,4-xlenol method of Hänni [Mitteilungen Lebensmittel-Hygiene, Bern (1951) 42 (2) 114-126]. Results were too high and non-reproducible because of interference from sucrose (formation of 5-hydroxymethylfurfural). This fault was eliminated by adding a gas chromatography phase (simultaneous with the colorimetry) to the procedure. Sensitivity of the modified procedure is claimed to be about 1 p.p.m. and reproducibility about 5%. ADL

68

[Effects of various additives and processing methods on red colour development in cured blood and blood sausage products.] Einfluss verschiedener Zusätze und Behandlungsverfahren auf die Umrötung von Blut- und Blutwurst-Erzeugnissen. [Thesis] Makodi, A. B. 74pp. (1975) [126 ref. De, en] Munich, Federal Republic of Germany; Fachbereich Tiermedizin, Ludwig-Maximilians-Universität

An extensive discussion of the literature on blood pigments and their reactions, colour retention of meat and meat products, red colour development in cured products, and the toxicology of curing agents and their reaction products is given. Details are given of a series of experiments covering: effects of temp., storage time, O₂ content and curing agents on cured pigment formation, pH, and nitrite or nitrate concn. in blood; effects of temp., storage time and curing aids on cured pigment formation in blood in the absence of nitrite curing salt; effects of pH and various curing aids on red colour development during heating at 80°C; effects of pH and cysteine on formation and stability of cured pigments in blood + nitrite curing salt or NaCl, heated at 80°C; and formation and stability of red colour in a blood/pork rind product in dependence on additives and storage time. Numerous tables of results are given. Aeration of the blood improved cured colour formation, as did adding NaNO₂ over a period of several days. Heated samples show a lower content of NO-haem pigments than raw samples. 120 p.p.m. added NaNO₂ was reduced to 2.5 p.p.m. after 2 days. A surprisingly high level of formation of NO haem pigment (≤ 79.0% conversion) was recorded for samples heated without nitrite; this is due to presence of nitrates in the blood,

and to other haem derivatives with max. extinction at similar wavelengths to nitrosopigments. Sodium ascorbate, cysteine, glucono- δ -lactone, glucose, lactose, nicotinamide and monosodium glutamate did not give a reliable increase in red colour formation. Acidification to pH 5.7–6.0 with citric acid did not increase NO-haem pigment concn., but gave a bright red colour to the product. AJDW

69

[Ways of reducing nitrite in large-diameter sausages.] Raseta, J.; Kepcija, D.; Babic, L.; Simovic, D.; Popovic, J. *Tehnologija Mesa* 19 (4) 98–101 (1978) [17 ref. Sh, en] [Vet. Fak., Belgrade, Yugoslavia]

As has been proved, a 30–50 mg/kg addition of NaNO_2 is sufficient to appreciably reduce the nitrite concn. in Frankfurter sausages, and to completely eliminate nitrosamine formation, which begins at a nitrite concn. of 1 g/100 kg emulsion. Research was conducted to find out whether low concn. of nitrite can be used in large sausages, e.g. Paris sausage, without impairing colour. The emulsion for this sausage consists of 70% meat, 30% hard fatty tissue and spices, and is stuffed into artificial casings 97 mm in diam. When 30–50 mg/kg NaNO_2 is added, the colour and aroma of Paris sausage are normal. Residual nitrite concn. decrease further during storage for 7 days at 5°C. STI

70

The interaction of nitrites with food, drugs, and contaminants. [Review] Greenland, S.

Journal of Environmental Health 41 (3) 141–143 (1978) [34 ref. En] [Div. of Epidemiology, School of Public Health, Univ. of California, Los Angeles, California 90024, USA]

71

Nitrate and nitrite levels in fresh spinach as influenced by postharvest temperatures.

Aworh, O. C.; Brecht, P. E.; Minotti, P. L. *Journal of the American Society for Horticultural Science* 103 (3) 417–419 (1978) [13 ref. En] [Dep. of Vegetable Crops, Cornell Univ., Ithaca, New York 14853, USA]

Various postharvest temp.-time combinations on nitrate-nitrite conversion in fresh spinach (*Spinacia oleracea* L.) were investigated. At 0°C spinach could be held as long as 40 days without significant changes in these N components. Substantial loss of nitrate-N and accumulation of nitrite-N occurred in spinach held for 3 to 7 days at 20°C. Simulated transit periods of 2 wk at 0 and 5°C and simulated marketing periods of 3 days at 10°C were imposed separately and in sequence to spinach in pretransit storage for 15 h at 21°C or to spinach without a pretransit storage period. Accumulations of nitrite-N exceeding 2 p.p.m. fresh wt. were found only if the simulated transit period was 5°C. In this instance pre- and post transit storage further increased nitrite accumulation. Nitrite-N levels exceeding 10 p.p.m. were found only in visibly decayed samples. AS

72

[The nitrate content of vegetables.] Über den Nitratgehalt von Gemüse. [Review] Ventner, F.

Industrielle Obst- und Gemüseverwertung 63 (5) 117–120 (1978) [many ref. De] [Tech. Univ. München, Weihestephan, Federal Republic of Germany]

This review discusses effects of N fertilization and type of produce on the NO_3^- content of vegetables, and the unavoidable variations which make it impossible to guarantee low concn. in the raw material even without N fertilization. RM

73

[Nitrates and nitrites in milk and dairy products.] Bertelsen, E.

Nordisk Mejeriindustri 5 (12) 617–619, 636 (1978) [3 ref. Sv] [Sektion för Mejeriteknik, SMR, Malmö, Sweden]

The author discusses the problem of nitrates, nitrites and carcinogenic N-nitroso compounds (especially nitrosamines) in dairy products. About 90 N-nitroso compounds have been shown to cause tumours in experimental animals, although their significance for human cancer needs further investigation. Norway has prohibited use of nitrate in food since 1973 (with certain exceptions). Sweden permits addition of saltpetre to cheese milk, up to a max. of 0.2 g/kg. Methods of determining nitrate, nitrite and nitrosamines are reviewed, and Scandinavian investigations into the levels and sources of these substances in milk and cheese are discussed. It is pointed out that milk or whey intended for drying must be carefully tested for nitrate contamination, because drying increases the concn. 20 times. Sweden tolerates ≤ 200 mg nitrate and ≤ 5 mg nitrite/kg dried whey, and ≤ 20 mg nitrate and ≤ 5 mg nitrite/kg dried milk for use as human food. Dairies which use the same driers for both milk and whey must take particular care when switching from one product to the other. ADL

74

[Pigment formation during curing of meat.

V. Reaction of nitrite with porcine muscle.] Bilanz der Bildung von Pökelfarbstoff im Muskelfleisch. V. Reaktionen von Nitrit mit Schweinemuskel. Möhler, K.; Scheerer, C.

Zeitschrift für Lebensmittel-Untersuchung und -Forschung 168 (3) 173–176 (1979) [11 ref. De, en] [Inst. für Ernährungswissenschaften, Tech. Univ. München, D-8050 Freising-Weihestephan, Federal Republic of Germany]

Studies were conducted on reaction of nitrite with constituents of light and dark porcine muscle. Samples of 100 g muscle homogenate were mixed with 10 ml NaCl solution (22 g NaCl/100 ml) and 5 ml of NaNO_2 solutions of various concn. The reaction mixtures were heated for 20 min at 50°C, then 90 min at 75°C, and finally cooled. Contents of total pigments, 'cured' pigments and residual nitrate and nitrite were determined. Tables and graphs of results are given. The results show that the % nitrite bound by myoglobin is

higher for dark than for light pork muscle (average values 4.66 and 1.68% resp.); binding of nitrite by unidentified constituents was greater for light than for dark muscle (average values 34.85 and 17.79% resp.). Nitrate formation was slightly greater in dark than in light muscle (average values 2.78 and 2.04% resp.). Comparison with data for beef suggests that nitrite consumption by pork is only slightly lower than nitrite consumption by beef, in spite of the considerable difference in haem pigment concn. [See also FSTA (1972) 4 6S743.] AJDW

75

[Curing problems.] Bemerkungen zum Problem Pökeln. [Review]
Prändl, O.

Fleischwirtschaft 58 (12) 1909-1911; 1965-1967 (1978) [17 ref. De, En] [Vet. Med. Univ. Vienna, Linke Bahngasse 11, 1030 Vienna 111, Austria]

The reduction of NO_3^- and NO_2^- added to meat products is reviewed, especially in relation to economic and health hazards. In the absence of alternative methods, a balance must be struck between the risks of nitrosamine formation and food poisoning. Residual NO_2^- can be lowered by ascorbic acid addition (e.g. molar ratio of ascorbic acid: NO_2^- of 2:1). In the case of fully-preserved meat products, 1% NO_2^- curing salt would ensure reddening and flavour formation. In any case it should be limited to 2%. No universal limit can be laid down for NO_3^- (at present indispensable for certain fermented meat products) as the amount required depends on the time of ripening: (e.g. 300 mg NO_3^- /kg was insufficient to prevent spoilage of dry sausages during 10 wk ripening but enough for 3 wk ripening. From the point of view of technology and hygiene, limiting the residual NO_3^- in finished products would be more effective. The repeated use of curing brines is discouraged because of possible bacterial contamination and nitrosamine formation. RM

76

USDA acts on the bacon dilemma: alternatives promise a reprieve.

O'Brien, M. T.

Food Product Development 12 (6) 32, 34-37 (1978) [4 ref. En]

Because of widespread concern with the use, necessity and toxicity of nitrates/nitrites, the USDA published a final rule and a proposal on bacon processing, effective from June 15, 1978. The rule states that all bacon processed using nitrite must employ 120 p.p.m. ingoing sodium nitrite (or 148 p.p.m. potassium nitrite) to prevent the formation of botulinal toxin and 550 p.p.m. sodium ascorbate or sodium erythorbate to inhibit the formation of nitrosamines. All bacon will have to be analysed using a Thermal Energy Analyzer and be free of nitrosamines at a 'confirmable' level (10 parts/billion (p.p.b.)). In 1 yr the max. confirmable level will drop to 5 p.p.b. The tested bacon must be cooked at 340°F for 3 min on each side to assure standardized sample preparation. Consideration is also given to: how ascorbate functions; further proposal to modify the original; the sorbate saga; and researching other alternatives to the botulism/nitrosamine dilemma. VJG

77

Quality of boneless dry-cured ham produced with or without nitrate, netting or potassium sorbate.

Kemp, J. D.; Langlois, B. E.; Solomon, M. B.; Fox, J. D. *Journal of Food Science* 44 (3) 914-915 (1979) [En] [Dep. of Anim. Sci., Univ. of Kentucky, Lexington, Kentucky 40506, USA]

2 trials were conducted. In (i), boneless hams were cured with salt, sugar, KNO_3 + NaNO_2 or salt, sugar and nitrite only. Half of the hams in each group were tied with heavy twine and half were enclosed in elastic netting. There were no differences in any variable due to the presence or absence of nitrate. Hams that were netted had higher yields after curing and ageing, and also had more desirable general appearance than tied hams. There were no differences in composition, palatability scores or tenderness. In (ii) one group of boneless hams was dipped in 2.5% potassium sorbate solution, placed in elastic netting, cured and aged while a similar group was not dipped. Treated hams were slightly more desirable in general appearance, slightly higher in moisture and lower in nitrite. Flavour ($P < 0.05$) and overall satisfaction scores ($P < 0.01$) favoured the treated group. Saltiness scores also were lower ($P < 0.05$) in the treated group. Yeast and mould counts were lower ($P < 0.05$) for the treated groups after curing, after salt equalization and after ageing 1 month, indicating that potassium sorbate could be used successfully as a yeast-and-mould-retardant in cured hams. IFT

78

Effect of sodium nitrite on the stability of pasteurized canned meat.

Wojton, B.; Kossakowska, A.; Ryglewicz, Z.; Moczybroda, J.

Bulletin of the Veterinary Institute in Pulawy 22 (1/2) 38-41 (1978) [19 ref. En] [Dep. of Hygiene of Anim. Products, Vet. Res. Inst., Pulawy, Poland]

Studies on the storage stability of pasteurized canned comminuted pork containing 2.5% NaCl and (i) 0, (ii) 50, (iii) 100 or (iv) 200 p.p.m. NaNO_2 are described. The cans (capacity 340 g meat) were pasteurized at 69°C for 10 min, cooled, and held at 37°C until all cans were spoiled. The results show that all cans of 30-can batches of (i), (ii), (iii) and (iv) meat were spoiled after 8, 14, 22 and 28 days resp. Variance analysis by the F test showed the spoilage process to be linearly related to time, the slope differing between nitrite concn. Spoiled pasteurized canned meat samples contained *Clostridium perfringens*, *Cl. sporogenes*, *Cl. bifermentans*, enterococci and aerobic sporeforming bacilli. AJDW

79

Sodium nitrite and sorbic acid effects on *Clostridium botulinum* toxin formation in chicken frankfurter-type emulsions.

Sofos, J. N.; Busta, F. F.; Bhothipaksa, K.; Allen, C. E. *Journal of Food Science* 44 (3) 668-672 (1979) [En] [Dep. of Food Sci. & Nutr., Univ. of Minnesota, 1334 Eckles Avenue, St Paul, Minnesota 55108, USA]

C. botulinum growth and toxin production and residual nitrite depletion were studied in a mechanically

deboned chicken meat (MDCM) frankfurter-type product, during 27°C temp. abuse. A series of 3 trials was conducted in order to determine the effects of NaNO_2 and sorbic acid on the above parameters. Low nitrite concn. (20 and 40 µg/g), did not influence *C. botulinum* growth and toxin production. Addition of sorbic acid (0.2%) to these nitrite levels resulted in a significant extension of the time necessary for toxin to develop. The 0.1% sorbic acid level was ineffective. Nitrite concn. of 156 µg/g doubled the time necessary for botulinal toxin production, as did 0.2% sorbic acid alone. The magnitude of toxin production delay was increased 5 fold when 156 µg/g nitrite and 0.2% sorbic acid were combined. Nitrite depletion was rapid during processing and 27°C incubation. Low residual nitrite concn. were present for a longer time in nitrite-sorbic acid combination treatments, indicating that the presence of sorbic acid may delay depletion of residual nitrite. Gas production and spoilage of the product followed the same rate of development as toxin. IFT

80

The accumulation of unacceptably high levels of nitrite in vacuum packed back bacon.

Jolley, P. D.

Journal of Food Technology 14 (1) 81-87 (1979) [8 ref. En] [Meat Res. Inst., Langford, Bristol BS18 7DY, UK]

Backs from 2 bacon wt. pigs, one of high ultimate pH (pH_u) and the other of normal pH_u , were slice cured with either nitrate free or nitrate containing brines and then stored in vacuum packs. Microbiological conditions likely to occur in chemically similar bacons produced by the traditional Wiltshire method were produced in 1/2 the packs using an inoculum from mature Wiltshire bacon sides. Changes in nitrite concn. were followed in the *M. longissimus dorsi* and in the total slice during storage at 5°C. Although the initial levels of nitrite and nitrate (where added) in the total slice were within currently permitted limits, rapid conversion of nitrate, and with little or no nitrite depletion produced 380 p.p.m. NaNO_2 within the 1st wk of storage in the inoculated bacon from the high pH_u pig. The implications of these findings with regard to commercial practice are discussed. AS

81

Acid-producing micro-organisms in meat products for nitrite dissipation.

United States of America, Food Safety & Quality Service

Federal Register 44 (31, Feb. 13) 9372 (1979) [En] [USDA, Washington, DC, USA]

The Federal meat inspection regulations are revised to permit the use of acid-producing microorganisms such as lactobacilli, naturally present on the surface of meat and meat products, in the processing of bacon to lower the pH in order to dissipate residual nitrite and reduce nitrosamine formation. CAS

82

Cheese - determination of nitrate and nitrite contents - method by cadmium reduction and photometry.

International Organization for Standardization
International Standard ISO 4099-1978, 6pp. (1978) [En]

This standard is identical with IDF [International Dairy Federation] Standard 84:1978 [see FSTA (1979) 11 3U143]. AL

83

[Presence of nitrates in water for the food industry.]
Vanossi, L.

Industria Alimentari 17 (11) 841-842 (1978) [It]

Methods for treatment and purification of waters intended for food industry use are considered and discussed with particular reference to use of ion exchangers for nitrate removal. SKK

84

[Nitrate in milk products and its simple determination by a rapid method.] Nitrat in Milchprodukten und seine einfache Ermittlung mit einer Schnellmethode.

Kaemmerer, K.; Fink, J.

Deutsche Tierärztliche Wochenschrift 85 (9) 357-361 (1978) [10 ref. De, en] [Bünteweg 7, 3000 Hannover-Kirchrode, Federal Republic of Germany]

Contamination of whey by nitrate, e.g. nitrate used as a preservative in cheesemaking, is discussed. 97 samples of milk products for infants and for livestock were used in a comparative study on detn. of nitrate by the standard xylenol method and by the rapid, clear and simple Merckoquant semiquantitative method (detection limit 1 µg/g). Good agreement was achieved, with or without deproteinization. Double estimations were recommended to reduce the risk of misreading the colour reaction. AJDW

85

Good bacon color is produced with only 40 p.p.m. nitrites.

Andres, C.

Food Processing 39 (12) 52-53 (1978) [En]

The use of sorbate/nitrite blends for bacon curing to produce the same level of *Clostridium botulinum* toxin inhibition while reducing nitrite levels in the finished product are discussed. The use of 40 p.p.m. sodium nitrite (49 p.p.m. potassium nitrite) with 0.26% potassium sorbate and 550 p.p.m. sodium ascorbate or isoascorbate (all on the basis of finished bacon wt.) is the basis of an FDA proposal to reduce permitted nitrite levels. JRR

86

Iron and the antibotulinal efficacy of nitrite.

Tompkin, R. B.; Christiansen, L. N.; Shaparis, A. B.

Applied and Environmental Microbiology 37 (2) 351-353 (1979) [8 ref. En] [Swift & Co., Res. & Development Cent., Oak Brook, Illinois 60521, USA]

Combinations of nitrite, isoascorbate, and ethylenediaminetetraacetic acid were compared for their antibotulinal efficacy in perishable canned cured meat. A dose response relationship of available Fe to the antibotulinal efficacy of nitrite was demonstrated. AS

87

[Use of special antiserum for identifying compounds formed in meat during brining.]

Chirkina, T. F.; Makushkin, E. O.

Izvestiya Vysshikh Uchebnykh Zavedenii, Pishchevaya Tekhnologiya No. 5, 162-163 (1978) [6 ref. Ru] [Vostochno-Sibirskii Tekh. Inst., USSR]

Immunoelectrophoresis was used to investigate formation of complexes of proteins with NO_2^- ions during meat brining. Following electrophoresis on agar, the proteins were identified serologically using a precipitation reaction. Specific antiserum was obtained via rabbit immunization. The precipitation bands show that there are proteins, modified by the NO_2^- ion, in the brined meat. Electrophoretic separation shows that the complexes of sarcoplasmatic proteins with nitrites possess globulin-like mobility. STI

88

[Effect on NaNO_2 on the post mortem breakdown of ATP and glycogen in pork muscle.] Über den Abbau von Adenosintriphosphat und Glykogen unter dem Einfluss von Natriumnitrit im Schweinemuskel post mortem.

Ivanov, N.; Nestorov, N.; Profirov, J.; Tontscheva, E.; Petkova, O.; Dineva, B.

Fleischwirtschaft 58 (11) 1846-1848; 1820 (1978) [22 ref. De, en] [Inst. for the Meat Ind., 65 Boulevard Cherni Vrah, Sofia, Bulgaria]

The effects of adding 8 mg% NaNO_2 to pork (*M. longissimus dorsi*) minced 2 h after slaughter were studied during 48 h. Diagrams show the changes in nucleotide, nucleoside, glycogen and lactic acid concn., pH, Mg- and Ca-ATPase activity at 0, 3, 6, 24 and 48 h. The first 6 h were marked by rapid fall in ATP concn., rise in ADP and low levels of AMP. Added NaNO_2 accelerated the breakdown of nucleotides to nucleosides, delayed glycogen breakdown and initial increase in lactic acid concn., had no effect on pH or on Mg-ATPase activity, and reduced Ca-ATPase activity after 6 h. It had little effect on nucleotide and nucleoside concn. after 48 h. RM

89

[The effect of nitrite reaction products on *Clostridium sporogenes* in heat-treated meat products.] Die Wirkung der Reaktionsprodukte von Nitrit auf *Clostridium sporogenes* in erhitzten Fleischerzeugnissen.

Roon, P. S. van

Fleischwirtschaft 59 (4) 505-512; 542-544 (1979) [many ref. De, en] [Fak. der Diegeneeskunde, Rijksuniv. Utrecht, Biltstraat 172, 3572 PB Utrecht, Netherlands]

The inhibition of clostridial growth by NO_2^- reaction products was studied in model culture media (tryptone-yeast extract-agar) and in meat products. The following conclusions were reached: Perigo-type inhibitors [Journal of Food Technology (1967) 2, 377-397 and (1968) 3, 91-94] did not inhibit growth in heated cured meat products; NO_2^- required for formation of these compounds was lost for inhibition. S-NO-thiols (e.g. S-NO-cysteine) contributed to inhibition but could not substitute for NO_2^- . Reduction of NO_2^- levels in cured meat by adding 1.0 g sorbic acid/kg could not be

recommended for pasteurized cured meats (lean ham, sausages). The investigation indicated that, of additives studied, NO_2^- is the only one to give satisfactory inhibition of clostridial growth in heated cured meats containing 20-25 g NaCl/kg and at pH 6.1-6.5. RM

90

Automated system for sodium nitrite, sodium nitrate, and sodium chloride in meat products. [Lecture]

Bergman, N. C.

Advances in Automated Analysis. Technicon International Congress 2, 190-194 (1977) [6 ref. En] [Chem. Lab., Geo. A. Hormel & Co., Austin, Minnesota 55912, USA]

An automated method for detn. of sodium nitrite, sodium nitrate and sodium chloride in meat products ranging from cured meat products to canned items is described. The method involves using a dual-channel AutoAnalyzer II system, composed of a sampler IV, pump III, appropriate manifolds, colorimeter and a dual channel recorder. Results obtained by this system are compared to those using AOAC manual methods. [See FSTA (1979) 11 9A636.] SP

91

Influence of sodium nitrite on the aerobic catabolism of glucose by *Staphylococcus aureus*.

Buchanan, R. L., Jr.; Solberg, M.

Journal of Food Safety 1 (3) 189-200 (1978) [19 ref. En] [Dep. of Food Sci., Rutgers, State Univ., New Brunswick, New Jersey 08903, USA]

The inhibitory effect of sodium nitrite upon glucose catabolism by *Staphylococcus aureus* was investigated using [$U\text{-}^{14}\text{C}$] glucose, liquid chromatography, and GLC. Acetate and acetoin were the end-products of glucose metabolism by *S. aureus* at 37°C and pH 6.3. In the presence of inhibitory levels of sodium nitrite, acetate and lactate with traces of pyruvate and acetoin were the end products. Acetate production/unit of growth was significantly lower in the sodium nitrite inhibited cultures. The decreased acetoin accumulation was not due to inhibition of diacetyl reduction. The production of acetoin was induced by the addition of acetate to the sodium nitrite containing medium. AS

92

Electron capture gas chromatographic determination of nitrates and nitrites in biological and environmental samples.

Tesch, J. W.

Dissertation Abstracts International, B 38 (7) 3165-3166; Order no. 77-29984, 160pp. (1978) [En] [Univ. of Colorado, Boulder, Colorado 80302, USA]

A method of analysis of nitrates and nitrites, applicable to a wide var. of samples including drinking water, was developed. Aqueous nitrate ion was converted to a nitroaromatic compound by reaction with benzene (or other aromatic reactant) in the presence of a catalyst. Nitrobenzene was determined quantitatively by electron capture gas chromatography. Nitrate ion was determined by difference after treatment of a 2nd identical sample with an oxidant, e.g. H_2O_2 ; this treatment oxidized all the nitrite to nitrate. The excellent sensitivity of the electron capture

detector for nitroaromatic compounds (e.g. detection limit approx. 1 pg for nitrobenzene) enables sub p.p.m. detn. to be made on a single drop of sample. SP

93

Nitrates and N-nitrosamines in cheese.

Gray, J. I.; Irvine, D. M.; Kakuda, Y.

Journal of Food Protection 42 (3) 263-272 (1979)

[109 ref. En] [Dep. of Food Sci., Univ. of Guelph, Guelph, Ontario, Canada]

Use of nitrate in manufacture of certain cheeses is sometimes questioned because of its potential involvement in formation of N-nitrosamines. Unlike cured meats, there was not much information available, until recently, regarding the presence of N-nitrosamines in cheese and other dairy products. This paper briefly reviews the mechanism of formation of such compounds in foods and discusses the necessity of selective and sensitive methods of analysis. Factors which may possibly influence formation of N-nitrosamines in cheese as well as further areas of research are also discussed. AS

94

A method for measuring the texture of meat and the effect of nitrite and salt addition on the texture of cured meats.

Randall, C. J.; Voisey, P. W.

Journal of Texture Studies 8 (1) 49-60 (1977) [18 ref.

En] [Food Res. Inst., Agric. Canada, Ottawa, Ontario K1A 0C6, Canada]

An instrumental technique was developed for measuring the texture of canned chopped ham using the 15 cm² wire extrusion cell of the Ottawa Texture Measuring System. Its measurement efficacy was evaluated by testing enzymically tenderized ham. This showed that the technique was sensitive to textural changes and that the level of the added enzyme affected the ham's texture exponentially. Nitrite addition to the canned chopped ham product at levels of 0-1000 p.p.m. did not affect its texture. The level of salt used in the curing solution, however, had a marked tenderizing effect. Similarly, compression tests on wieners indicated that nitrite addition did not influence their texture. It was concluded that the characteristic texture of the 2 products tested cannot be attributed to nitrite addition and that other factors such as the level of salt addition to the canned chopped ham must be responsible. AS

95

[Degradation of food additives by irradiation. III. Reaction of BHA with sodium nitrite or potassium nitrate by UV irradiation.]

Ishizaki, M.; Oyamada, N.; Uene, S.; Katsumura, K.; Hosogai, Y.

Journal of the Food Hygienic Society of Japan

[*Shokuhin Eiseigaku Zasshi*] 19 (3) 299-304 (1978)

[13 ref. Ja, en] [Ibaraki Hyg. Lab., Atago-cho, Mito, Japan]

BHA (butylated hydroxyanisole) and sodium nitrite or potassium nitrate in ethanol-water (4:1) solution were subjected to UV irradiation for 24 h at room temp. 4 reaction products such as 1,4-dimethoxy-2-

nitrobenzene were identified. 2-tert-butyl-quinone and 6 other structures were determined as the degradation products of BHA by UV irradiation. [See *FSTA* (1976) 8 7T300 for part I.] TM

96

An improved method for nitrite extraction from plants.

Klepper, L. A.

Journal of Agricultural and Food Chemistry 27 (2) 438-441 (1979) [12 ref. En] [Dep. of Agron., Univ. of Nebraska, Lincoln, Nebraska 68583, USA]

An improved technique for aqueous extraction of nitrite from plant tissues is described. Additions of methylene chloride (MeCl₂) and insoluble polyvinylpyrrolidone (PVP) produced clear, aqueous nitrite-containing extracts. In tea solutions, the MeCl₂/PVP treatment allowed approx. 95% recovery of added nitrite, compared with 43% when nitrite was added to untreated tea solution. The MeCl₂/PVP addition increased recoveries of nitrite from all 15 plant spp. tested (including spinach leaves, sweet potato, radish, and potato tubers). AL

97

Preparation of nitrate and nitrite reductases and their application to chemical analysis.

Kiang, C. H.

Dissertation Abstracts International, B 38 (11) 5320: Order no. 77-28420, 185pp. (1978) [En]

A newly developed specific and sensitive method for analysis of nitrate and nitrite uses an enzymic approach and electrochemical and fluorometric methods. The enzymes used are MVH(methyl viologen, reduced form)-nitrate reductase induced from *Escherichia coli*, MVH-nitrite reductase isolated from spinach leaves and NADH(nicotinamide adenine dinucleotide, reduced form)-nitrate reductase induced from *Chlorella vulgaris*; the first 2 enzymes are purified and immobilized, while the third is highly purified by affinity chromatography. An air gap electrode is used to monitor NH₃ formed by the reducing action of MVH-nitrate and -nitrite reductases on nitrate and nitrite. A silicone-rubber pad fluorometric method is used to measure rate of decrease of NADH during assay of nitrate with NADH-nitrate reductase. Detection limits are 5 × 10⁻⁵M nitrate or nitrite for the air gap electrode and 1 × 10⁻⁶M nitrate for the fluorometric method. The new method has been successfully applied to meat and water samples. JA

98

[Determination of nitrite by means of chromotropic acid.]

Cuzzoni, M. T.; Gazzani, G.

Industria Alimentari 18 (2) 130-132 (1979) [15 ref. It]

[Dipartimento di Chimica Farmaceutica, Univ. degli Studi di Pavia, Pavia, Italy]

A simple, rapid procedure for detn. of nitrite in aqueous solutions (including food extracts) is described, based on mixing of 10 ml of the solution under test (containing 2-8 mg nitrite/l.) with 10 ml of a solution of 0.025 g chromotropic acid in 100 ml conc. H₂SO₄. The

mixture is then held at 110–120°C for 5 min, cooled under running water, and made up to 25 ml with water; after 30 min, extinction at 435 nm is determined. Extinction value is linearly related to nitrite concn. over the range 2–8 mg nitrite/l. Nitrite concn. in the sample under test is calculated by means of standard curves. Reproducibility is good. This method permits rapid detn. of nitrite, using the same reagents which may, under different analytical conditions, be used for detn. of nitrate and formaldehyde. AJDW

99

Determination of nitrate at low level without prior extraction and its differentiation from nitrite.

Walters, C. L.; Hart, R. J.; Perse, S.

Zeitschrift für Lebensmittel-Untersuchung und -Forschung 169 (1) 1–3 (1979) [5 ref. En, de] [British Food Manufacturing Ind. Res. Ass., Leatherhead, Surrey, UK]

A reagent containing TiCl_3 and HBr was developed that converts nitrate to a form, presumably nitrite, releasing NO on acidification. Thus, addition of the reagent to a food or other dried matrix containing nitrate leads to evolution of NO , which can be determined using a chemiluminescence analyser. Any nitrite also present on the matrix can be differentiated from nitrite by the NO released using acetic acid prior to the addition of the TiCl_3 reagent. The coeff. of variation for the NO responses from 1.0 μg and 10 μg of KNO_3 were 12 and 9.2%, resp. At a level of 10 μg of KNO_3 , $97.8 \pm 4.2\%$ of NO expected from an equivalent amount of nitrite was obtained from nitrate, following reduction with the TiCl_3 reagent. Ascorbic acid did not interfere with the detn. of nitrate in this manner, but a similar NO response was obtained from $\text{N-nitrodimethylamine}$. AS

100

Nitrites and nitrosamines in our environment: an update.

Wolff, I. A.; Wasserman, A. E.

Abstracts of Papers, American Chemical Society 177 (1) AGFD 10 (1979) [En] [E. Regional Res. Cent., 600 E. Mermaid Lane, Philadelphia, Pennsylvania 19118, USA]

Attention is focused on recently developed information relevant to the occurrence, human exposure and human safety aspects of nitrates and nitrosamines. Recent trends and benefit/risk factors are reviewed. AL

101

[Nitrate levels in foods for infants, and estimation of nitrate uptake from the diet.]

Bisazza, M. C.; Siena, E. de; Quattrucci, E.; Allegrini, M.; Griziotti, A.

Rivista della Società Italiana di Scienza dell'Alimentazione 7 (5) 373–380 (1978) [31 ref. It, en] [Istituto Nazionale della Nutr., Rome, Italy]

NO_3^- was determined by a selective electrode method in numerous samples of baby foods of various types, including dried milk, milk substitutes, cereal products (with or without meat, fruit, vegetables, etc.), homogenized meat-based or fruit-based products,

freeze-dried meat, fish or vegetable products, mineral water, and fruit juices. Tables of data are given showing number of samples, mean values (with s.d.) and range; estimates of daily intake of nitrates from the diet by infants of various ages are also given. Nitrate concn. recorded in baby foods ranged from 0 to 675 p.p.m., the highest values generally being recorded for products containing vegetables; considerable differences were observed between nitrate concn. in similar products. The calculated daily average nitrate intake was lower than the FAO/WHO acceptable daily intake/kg body wt. for adults; no acceptable daily intake levels for infants are available. AJDW

102

Nitrate-nitrite, vitamin C and in-vitro methemoglobin formation from some vegetables.

Okiei, W.; Adamson, I.

Nutrition Reports International 19 (2) 241–248 (1979) [20 ref. En] [Dep. of Biochem., Univ. of Benin, Benin City, Bendel State, Nigeria]

The contents of nitrate, nitrite and vitamin C in 11 samples of fresh vegetables were determined. The levels of nitrate were $>$ the 300 p.p.m. recommended level in 6 of the vegetables, namely: *Celosia* sp., *Lactuca sativa*, *Amaranthus hybridus*, *Brassica oleracea* var. *acephala*, *Talinum* sp., and *Spinacia oleracea*. Minute quantities of nitrite were detected in *Celosia* sp. and *Daucus carota*. With accompanying high concn. of vitamin C (a reducing agent) present in *Celosia* sp., this vegetable may be a potential source of nitrite in foods. Cooking caused $<25\%$ reduction in nitrate-nitrite content of the vegetables. When an in vitro test of methaemoglobin formation was carried out with extract from the samples, modified haemoglobin formed was similar to content of nitrate in the vegetables. It is suggested that caution must be exercised in the use of some of these vegetables in infant foods as they may contribute to induction of methaemoglobin. AS

103

[Balance-sheet of formation of cured pigments in meat. VI. Comparison between retail meat products and model studies using meat and nitrite.] Bilanz der Bildung von Pökelfarbstoff im Muskelfleisch.

VI. Bilanzvergleich zwischen Fleischerzeugnissen des Handels und Modellversuchen mit Muskelfleisch und Nitrit.

Möhler, K.; Scheerer, C.

Zeitschrift für Lebensmittel-Untersuchung und -Forschung 168 (5) 381–388 (1979) [21 ref. De, en] [Inst. für Ernährungswissenschaften, Techn. Univ. München, D-8050 Freising-Weihenstephan, Federal Republic of Germany]

Aspects covered in this paper include: nitrite and nitrate concn. in commercial sausages of various types; nitrate formation from nitrite in sausages; effects of addition of ascorbate and cold storage on nitrate formation in model studies; and effects of heat treatment on binding of nitrite to haem pigment-free meat. Numerous tables and graphs of results are given. Studies on commercial sausage samples showed nitrate concn. to be considerably greater than anticipated; model studies showed conversion of nitrite to nitrate to be considerably increased by ascorbate addition, and to

increase during cold storage, the effect of ascorbate being greater for beef than for pork. Appreciable binding of nitrite to haem pigment-free meat samples was observed after heating at 75°C for 100 min, but not in non-heated samples. The results are discussed in detail, with reference to the applicability of results of model studies to actual meat products. Addition of 100 p.p.m. NaNO_2 gives a residue concn. of 10–30 p.p.m. in the final sausage, approx. 45 p.p.m. are used in cured pigment and nitrate formation, and approx. 5 p.p.m. in side reactions; the rest is bound to constituents other than haem pigments, the nature of this binding being unknown. AJDW

104

Nitrite content and composition of bacon produced in NSW.

Perryman, D. L.; Nassif, W. S.

Food Technology in Australia 30 (7) 273–276 (1978) [45 ref. En] [Div. of Analytical Lab., Health Commission of NSW, PO Box 162, Lidcombe, NSW 2141, Australia]

Between 1974 and 1977 100 samples of bacon produced commercially in New South Wales were analysed. The 300 g samples of bacon were divided into 2 portions, one of which was double minced and the other was separated into lean meat and fat, and then each component was double minced separately. The samples were analysed, on the day of preparation, for nitrite, fat, protein, ash, TS and phosphate. Mean and range of residual nitrite in whole bacon, and in fat, lean and aqueous phase of bacon are listed. Apart from 2 samples, more nitrite was found in the lean portion than in the fat. 15 samples of bacon contained > 150 mg potassium nitrite/kg, the max. concn. permitted under the NSW Pure Food Act. Of the remaining samples analysed, 78 samples (84%) contained < 100 mg potassium nitrite/kg, and they were acceptable in appearance and taste. Values of protein, fat, ash, added phosphate and TS in the bacon samples are tabulated. It is concluded that bacon of acceptable quality can be produced with about 100 mg residual nitrite/kg, and it is suggested that the max. residual level of nitrite in bacon should be equivalent to 100 mg potassium nitrite/kg. It is suggested that nitrate should be prohibited in the curing of bacon and that because of the possibility of nitrosamine formation during cooking of bacon, the setting of a max. permitted level of residual nitrite in bacon should be considered separately from permitted levels in other cured meat products. VJG

105

Plate waste of bacon cured with and without sodium nitrite.

Williams, J. C.; Greene, B. E.

Journal of Food Science 44 (4) 1260, 1262 (1979) [14 ref. En] [Dep. of Foods & Nutr., Univ. of Georgia, Athens, Georgia 30602, USA]

Bacon cured with and without NaNO_2 was served in a student dining hall as part of the regular breakfast menu selection. Plate waste was measured. Mean % plate waste was 13.7% and 13.4%, resp., for bacon cured with and without NaNO_2 . The presence or absence of NaNO_2 did not appear to be a determinant of the quantity of bacon consumed by these institutional food service facility patrons. IFT

106

Development of an unconventional approach to nitrification-denitrification.

Smith, E. D.

Dissertation Abstracts International, B 39 (1) 318: Order no. 78-10854, 171 pp. (1978) [En] [Texas Tech. Univ. Lubbock, Texas 79406, USA]

Use of municipal waste water for irrigation purposes can result in pollution of underlying aquifers with nitrates, leading to public health problems (e.g. methaemoglobinaemia in infants, caused by excessive nitrate and/or nitrite concn. in drinking water) and to eutrophication (i.e. over-fertilization of lakes and estuaries with plant nutrients, especially N and P). The feasibility of using an unconventional system for nitrifying and denitrifying sewage effluent was evaluated. The system involves stopping nitrification at the nitrite stage, at which point denitrification is promoted. Results of the evaluation indicated that the system exhibits potential for the development of an economic and effective method of N control. JA

107

Bacterial membrane electrode for the determination of nitrate.

Kobos, R. K.; Rice, D. J.; Flournoy, D. S.

Analytical Chemistry 51 (8) 1122–1125 (1979) [22 ref. En] [Dep. of Chem., Virginia Commonwealth Univ., Richmond, Virginia 23284, USA]

A novel potentiometric sensor has been devised for nitrate by coupling the bacterium *Azotobacter vinelandii* with an ammonia gas-sensing electrode. Nitrate is reduced to ammonia by a 2-step process involving the nitrate and nitrite reductases contained in the bacterial cells. Response of the bacterial sensor is linear over the concn. range 1×10^{-5} – 8×10^{-4} M with a slope between 45 and 50 mV/decade. The electrode is useable for a period up to 2 wk. Nitrate-containing samples (including drinking water) were analysed with an accuracy and precision between 3 and 4%. Advantages of using intact bacterial cells instead of isolated enzymes to carry out the multistep reduction are discussed. AS

108

Determination of nitrite in water by extractive esterification with higher alcohols.

Chao, M. K.

Dissertation Abstracts International, B 38 (7) 3159–3160: Order no. 77-28847, 91 pp. (1978) [En] [Kansas Univ., Lawrence, Kansas 66044, USA]

New method for detn. of nitrite in water is described, based on simultaneous formation and extraction of alkyl nitrate from an acidified water sample by passing it through a column packed with XAD-2 beads coated with the corresponding higher alcohols, the latter acting both as reactant and extractant. The nitrite ester formed on the column is then eluted with acetone and monitored colorimetrically by Shinn's procedure. Mechanisms involved in concn. of nitrite as alkyl nitrite on the column are discussed. Experimental results showed that nitrite in water can be effectively conc. by this technique. Nitrite ions in water may be determined.

at a concn. of 10^{-8} M. No interference by other organic or inorganic compounds normally present in water was observed. AJDW

109

[Nitrate and nitrite contents in fish, molluscs and crustacea.]

Cantoni, C.; Cosi, G.; Renon, P.; Ardemagni, A.
Archivio Veterinario Italiano 29 (5/6) 164-165 (1978)
[3 ref. It, en] [Istituto di Ispezione degli Alimenti di Origine Anim., Univ. degli Studi di Milano, Milan, Italy]

Data are presented for nitrate and nitrite concn. in the flesh of 23 fish spp., 4 mollusc spp. (squid, cuttlefish, octopus and oyster) and 2 crustacea (scampi and shrimp), the intestines of 10 fish spp., and the roe of 7 fish spp. Max. nitrite and nitrate concn. recorded for edible tissues were resp., 16.9 p.p.m. (sea bream, *Pagellus mormynus*) and 52.3 p.p.m. (squid, *Loligo vulgaris*). AJDW

110

[Use of nitrate in raw dry sausages.]

Cantoni, C.; D'Aubert, S.; Renon, P.; Tenca, L.
Archivio Veterinario Italiano 29 (5/6) 128-131 (1978)
[37 ref. It, en] [Istituto di Ispezione degli Alimenti di Origine Anim., Univ. degli Studi di Milano, Milan, Italy]

Studies were conducted on 'Varzi' type raw dry sausages (wt. 400 g) made with 0, 80 or 200 mg nitrate/kg meat emulsion, all samples also containing 0.2 g sodium ascorbate/kg emulsion. The sausages were matured for ≤ 60 days; at intervals during maturation, the total count, counts of micrococci, Lancefield type D streptococci, *Escherichia coli* + coliforms and lactic acid bacteria, pH, a_w , and concn. of moisture, total protein, non-protein N, sarcoplasmic protein and myofibrillar protein were determined. Tables of results are given. The results show little difference between sausages made with the 3 nitrate levels tested, except that the sample without nitrate had a higher total count than that with 80 or 200 mg nitrate/kg (60×10^9 /g, vs. 18×10^9 /g and 18×10^9 /g, resp.). Streptococci, *E. coli* and coliforms were absent from all samples after 8 days maturation. It is concluded that, in spite of these relatively good results, raw dry sausages should contain nitrate to control growth of undesirable microorganisms. AJDW

111

The chemical behaviour of food additives. [Lecture]
McWeeny, D. J.

Proceedings of the Nutrition Society 38 (1) 129-133 (1979) [13 ref. En] [Food Lab., Min. of Agric, Fisheries & Food, Haldin House, Queen Street, Norwich, UK]

The chemistry of food additives, and 'anti-nutrient' behaviour in foods either by formation of toxic compounds from food components or by destruction of nutrients is briefly reviewed with respect to sulphites and SO_2 , and reactions of nitrites in food. The fact that much of the SO_2 added to food remains chemically unidentified is stressed, and some reactions that have been identified are summarized, with effects in thiamin, protein, ascorbic acid and reducing sugars/amino acids. Potential reactions of nitrites in foods are, in summary,

deamination of lysine, N-nitrosation of secondary amines (to form nitrosamines), C-nitrosation of phenols, S-nitrosation of thiols, and chelation with metals of haem pigments. Knowledge of the chemistry of a food additive enables prediction of some specific reactions in foods, but does not exclude the possibility of harmful action. [See FSTA (1979) 11 12A877.] DIH

112

[Ammonia, nitrites and nitrates in sodium chloride.]

Cantoni, C.; Beretta, G.; Bianchi, M. A.
Archivio Veterinario Italiano 29 (5/6) 166-167 (1978)
[2 ref. It, en, fr] [Istituto di Ispezione degli Alimenti di Origine Anim., Univ. degli Studi di Milano, Milan, Italy]

Studies on the concn. of NH_4^+ , NO_2^- and NO_3^- in sea salt are described. 10 samples of each of 3 grades of sea salt were studied: (i) salt direct from the salt-pans, (ii) coarse-grade kitchen salt, and (iii) refined salt. Ranges of values for (i), (ii) and (iii) resp. were (p.p.m.): NO_2^- , 0-0.45, 0-0.3 and 0-0.3; and NO_3^- , 0.3-1.7, 0.5-1.0 and 0.5-1.3. All samples were free from NH_4^+ . AJDW

113

Health laws and regulations - Sweden.

World Health Organization

International Digest of Health Legislation 29 (2) 446-459 (1978) [En] [Geneva, Switzerland]

A selection of Swedish health laws and regulations is presented including the following which relate to food hygiene: Ordinance No. 1 of the National Food Administration embodying a consolidated version of Instruction No. 808 of 16 Sept. 1971 concerning the National Food Administration, as last amended with effect from 1 Jan. 1977; Order No. 7 of 6 May 1977 of the National Food Administration on foreign substances in foodstuffs, contains tables laying down max. permitted levels in specified foodstuffs of various pesticides, aflatoxins, Pb, vinyl chloride etc.; Order No. 8 of 6 May 1977 of the National Food Administration prohibiting the sale of fish etc. from certain bodies of water, which contain excessive levels of Hg, dieldrin, DDT and/or PCBs; Order No. 9 of 6 May 1977 of the National Food Administration amending Order No. 22 of 1972 on milk and milk products, introduces new provisions prohibiting the sale for human consumption, or the use in the preparation of foodstuffs of powdered milk containing > 20 mg/kg of nitrates or > 5 mg/kg of nitrites. VJG

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FAB 48

NITRATES AND NITRITES IN MEAT PRODUCTS

SELECTED FROM VOLUME **12**

FOOD SCIENCE AND TECHNOLOGY ABSTRACTS

under the direction of

Commonwealth Agricultural Bureaux, Farnham Royal, Bucks; Gesellschaft für Information und Dokumentation, Frankfurt am Main; Institute of Food Technologists, Chicago; Centrum voor Landbouwpublikaties en Landbouwdocumentatie (Pudoc), Wageningen.

INTRODUCTION

Food Annotated Bibliographies (FABs) are collections of abstracts on specific topics in food science and technology. The topics are chosen by the staff of the International Food Information Service as being of particular interest or importance. The topics normally interest individual workers, who may not require the full information provided in Food Science and Technology Abstracts, from which the abstracts for FABs are taken. The size and the cost of the FABs are controlled as much as possible with the interests of individual workers in mind.

Titles of the FABs now available are given on the back cover of this booklet. For up-to-date lists of FABs or suggestions for new topics please write to the address on the back cover. New subjects are searched for at least the five most recent volumes of Food Science and Technology Abstracts. Thereafter each FAB is updated monthly. Copies of each months abstracts on any topic may be obtained as indicated on the back cover of this publication. At the end of each volume of up-dating, the abstracts are merged and made available as a separate supplement to the original FAB.

Some of the larger FABs have been divided into sections to facilitate use. FAB 47 also has a subject and author index provided.

Copies of all original articles referred to in the abstracts may be bought (or occasionally borrowed) from the International Food Information Service. A form for ordering these is provided at the end of this FAB.

Coverage of the subject has been restricted to that of Food Science and Technology Abstracts, which covers over 1200 of the important food journals, patents from 20 countries and books published world-wide. Every effort is made to include all significant references, but editorial discretion is used on the many articles of borderline interest. If the reader particularly needs an exhaustive search of the subject, we will be pleased to provide any other references that we have available. We would, in any case, encourage readers to write or telephone us with any comments or queries that they may have.

H. BROOKES

EDITOR

1

[Problems with nitrites and nitrates in foods.]

Lemieszek-Chodorowska, K.

Zywnie Czlowieka 5 (4) 295-299 (1978) [29 ref. Pl]

[Panstwowego Zakladu Higieny, Warsaw, Poland]

Problems with nitrate accumulation in vegetables, metabolism of nitrate to nitrite and nitrosamine formation are discussed, in relation to recommendations of the FAO-WHO Expert Committee on Food additives that nitrate and nitrite concn. in foods should be further restricted. In Poland, addition of ≤ 500 mg nitrate and ≤ 2000 mg nitrite/kg meat is currently permitted.

Studies several yr ago showed that 70% of vegetable samples (lettuce, spinach, carrots, Hamburg parsley, radishes) had nitrate contents exceeding 300 mg/kg (the recommended max. limit for foods for infants). A revision of the food additives and contaminants legislation in Poland is anticipated. IN

2

Symposium on present status and goals of collaborative studies on toxicology. [Conference proceedings]

United States of America, Association of Official Analytical Chemists

Journal of the Association of Official Analytical Chemists 62 (4) 832-916 (1979) [many ref. En]

Papers are published that were presented at the symposium held during the 92nd Annual Meeting of the AOAC held in Washington DC, 16-19 Oct., 1978. The papers include Comparison of studies on saccharin and sodium nitrite, by J. M. Taylor & V. H. Morgenroth III (pp. 883-888, 11 ref.). A further paper is abstracted individually [see following abstr.]. DIH

3

[Establishment of permissible concentration of nitrate and nitrite in drinking water.]

Vakysukovich, L. Ya.; Krasovskii, G. N.

Gigiena i Sanitariya No. 7, 8-11 (1979) [10 ref. Ru, en]

[Inst. Obshchei i Kommunal'noi Higieny im. A. N.

Sysina AMN SSSR, Moscow, USSR]

When evaluating water quality, contents of nitrites possessing a similar toxic effect on animals to that of nitrates need to be taken into account. A formula is proposed for establishing the total nitrate + nitrite contents of drinking water: $C_1 + 0.1C_2 = 1$, where C_1 and C_2 are the concn. (in mg/l) of nitrite and nitrate, resp. Max. permissible concn. of nitrate in drinking water is recommended as 1 mg/l. HBr

4

Nitrosamine reduction.

Unilever Ltd.

British Patent 1 537 334 (1979) [En]

Nitrite-cured meat products are treated with 6-alkoxy-1,2-dihydroquinolines to reduce the formation of nitrosamines. IFT

5

[Determination of nitrite and nitrate in cured meat.]

Lara, W. H.; Takahashi, M. Y.; Silveira, N.

Revista do Instituto Adolfo Lutz 38 (2) 161-166 (1978) [11 ref. Pt, en] [Inst. Adolfo Lutz, Sao Paulo, Brazil]

Follet and Ratcliff's method for detn. of NO_2^- and NO_3^- in meat products [See *Journal of the Science of Food and Agriculture* (1963) 14, 138-144] was simplified and successfully applied to 55 samples of ham and 45 of sausages from Sao Paulo city supermarkets. Tabulated results revealed only 1 sample (of sausage) with > 300 p.p.m. $\text{NO}_2^- + \text{NO}_3^-$ (expressed as NaNO_2). 10 other sausage and 7 ham samples contained > 200 p.p.m. RM

6

Effect of reaction products from nitrite on *Clostridium sporogenes* in heated cured meats.

[Thesis]

Roon, P. S. van

115 pp. (1979) [many ref. En, nl] [Rijksuniv., Utrecht, Netherlands]

After a detailed review of the literature on inhibition of clostridia by nitrite reaction products in meat and meat products, an extensive series of experiments is described. Aspects covered included: identification of Perigo-type inhibitory substances in culture media; Perigo-type inhibitors in meat products; inhibition by C-nitrosation products of meat components, sorbic acid + nitrite, or ethylnitrolic acid in a culture medium; and residual free and protein-bound nitrite in heated cured pork products. Numerous tables, etc. of results are given, and discussed in detail. It is concluded that: Perigo-type inhibitors do not contribute to clostridial growth inhibition in heated cured meat products; S-nitric oxide thiols may contribute to inhibition of clostridia in meat products, but are not a practical substitute for nitrite; combination with sorbic acid treatment cannot be recommended as a method for reduction of nitrite levels in pasteurized cured meat products; and that nitrite is the only additive yet tested to give satisfactory inhibition of clostridial growth in heated cured meats. AJDW

7

Effect of pork belly composition and nitrite level on nitrosamine formation in fried bacon.

Pensabene, J. W.; Feinberg, J. I.; Dooley, C. J.; Phillips, J. G.; Fiddler, W.

Journal of Agricultural and Food Chemistry 27 (4) 842-845 (1979) [25 ref. En] [E. Regional Res. Cent., Fed. Res. Sci. & Education Administration, USDA, Philadelphia, Pennsylvania 19118, USA]

A study was conducted to determine the effect of compositional factors (fat, moisture, protein) on nitrosamine formation in bacon prepared from matched pairs of pork bellies cut into thirds. The compositional factors varied significantly ($p = 0.05$) from section to section within the same side but did not vary from side to side within the same section of matched pair. Both N-nitrosopyrrolidine and N-nitrosodimethylamine were most highly correlated with residual and added nitrite and to a lesser degree with the compositional factors. AS

8

Influence of heme pigments, nitrite, and non-heme iron on development of warmed-over flavor (WOF) in cooked meat.

Igene, J. O.; King, J. A.; Pearson, A. M.; Gray, J. I. *Journal of Agricultural and Food Chemistry* 27 (4) 838-842 (1979) [26 ref. En] [Dep. of Food Sci. & Human Nutr., Michigan State Univ., East Lansing, Michigan 48824, USA]

Removal of meat pigments and/or addition of 156 mg/kg of nitrite significantly ($P < 0.001$) inhibited lipid oxidation in cooked meat, which suggested that haem pigments may catalyse autoxidation. Taste panel evaluation confirmed the beneficial effects of removal of haem pigments and addition of nitrite as a means of controlling the development of WOF. The % of bound haem iron in fresh meat pigment extract was slightly over 90% while the level of free non-haem iron was $< 10\%$. Cooking, however, released a significant amount of non-haem iron from bound haem pigments, which accelerated lipid oxidation in cooked meat. Thus, the increased rate of lipid oxidation in cooked meat is due to the release of non-haem iron during cooking, which catalyses lipid oxidation. Addition of 2% EDTA was shown to effectively chelate the non-haem iron and, thus, significantly reduced lipid oxidation. [Meat studied was beef *longissimus dorsi* and chicken breasts and thighs.] AS

9

Health laws and regulations - Hong Kong.
World Health Organization

International Digest of Health Legislation 29 (3) 571-572 (1978) [En] [Geneva, Switzerland]

A selection of Hong Kong health laws and regulations is presented including the following which relate to food hygiene: The Preservatives in Food (Amendment) Regulations 1977. LN 181 of 1977 (dated 26 July 1977) amend the Preservatives in Food Regulations in such a way as to restrict the amount of sodium nitrate and sodium nitrite that may be used in the preparation of preserved pork and Chinese preserved sausage; and the Food and Drugs (Composition and Labelling) (Amendment) Regulations 1977. LN 217 of 1977 (dated 30 Aug. 1977) lays down detailed standards for various types of cream. VJG

10

Health laws and regulations - Iceland.
World Health Organization

International Digest of Health Legislation 29 (3) 579-586 (1978) [En] [Geneva, Switzerland]

A selection of Icelandic health laws and regulations is presented including the following which relate to food hygiene: Order No. 269 of 4 Sept. 1973 on milk and milk products, has been made in pursuance of, inter alia, Law No. 12 of 17 March 1969 concerning health hazards and public health surveillance; Regulations No. 286 of 28 Sept. 1973 on the processing and marking of poultry slaughterhouse products, have been made in pursuance of Law No. 30 of 28 April 1966; and Order No. 243 of 30 July 1974 on levels of nitrites and nitrates in meat, meat products and other slaughterhouse products, has been made in pursuance of Law No. 85 of 31 Dec. 1968. VJG

11

[Drinking water. Determination of nitrites.]

Colombia, Instituto Colombiano de Normas Tecnicas *Colombian Standard ICONTEC 1208*, 4pp. (1978) [Es] [Apartado Aereo 14 237, Bogota 2, Colombia]

A method for detn. of nitrite concn. in drinking water is specified, based on the sulphanilic acid/1-naphthylamine procedure, with optical density measurement at 520 nm, and subsequent calculation of nitrite concn. in the water sample by reference to standard curves. This method is applicable to samples with nitrite concn. $\geq 1 \mu\text{g}/\text{dm}^3$. AJDW

12

Effects of pH and sodium chloride concentration on the reaction between nitrite and sulfanilic acid/N-(naphthyl)ethylenediamine.

Hildrum, K. I.

Journal of the Association of Official Analytical Chemists 62 (4) 956-958 (1979) [11 ref. En] [Norwegian Food Res. Inst., Osloveien 1, 1432 As-NLH, Norway]

Effects of pH and NaCl concn. on formation of an azo dye from an intermediate diazonium salt were studied with reference to tests used for nitrite in food products. Nitrite reacted with sulphanilic acid/N-(naphthyl)ethylenediamine (NED) in citrate/phosphate buffer or HCl/citrate buffer with rate having a pH optimum at 3.0 in both cases. Rate was higher in HCl/citrate buffer. Reaction of nitrite with sulphanilic acid/1-naphthylamine also showed a pH optimum, at pH 2.5. Addition of NaCl significantly increased reaction rates. It is postulated that the reaction involved in the current AOAC method for analysis of nitrite, using sulphanilamide and NED, will also show a pH optimum and that the rate will be dependent on NaCl concn. Since no allowance is made in the AOAC method for differences between food samples in pH or salt content, such variations may cause errors in detn. of nitrite content. DIH

13

Nitrite-lipid reaction in aqueous system: inhibitory effects on N-nitrosamine formation.

Kurechi, T.; Kikugawa, K.

Journal of Food Science 44 (5) 1263-1266, 1271 (1979) [24 ref. En] [Tokyo Coll. of Pharmacy, 1432-1 Horinouchi, Hachioji, Tokyo 192-03, Japan]

The chemical interaction of lipids and lipid-containing foods with nitrite in a mild acidic aqueous system was investigated. Methyl linoleate-coated silica gel, Intralipid [an emulsion containing soybean oil and yolk lecithin], cows' milk, mayonnaise, yolk and miso reduced a considerable amount of nitrite. Methyl linoleate-coated silica gel and cows' milk extensively prevented the formation of carcinogenic N-nitrosamines. It seemed likely that the unsaturated fatty acid residues were responsible for the interaction of lipids with nitrite. Methyl linoleate was changed into two or more unidentified products, neither of which was the hydroperoxides of the ester. IFT

14

Redox potential-dependent nitrite metabolism by *Salmonella typhimurium*.

Page, G. V.; Solberg, M.

Applied and Environmental Microbiology 37 (6) 1152-1156 (1979) [24 ref. En] [Dep. of Food Sci., Cook Coll. Rutgers, The State Univ., New Brunswick, New Jersey 08903, USA]

Salmonellae are generally resistant to the inhibitory effects of NaNO_2 . Removal of the lipopolysaccharide of *S. typhimurium* by EDTA pretreatment did not result in subsequent inhibition of growth by NaNO_2 , indicating that lipopolysaccharide does not function to exclude NaNO_2 from the cell. NaNO_2 disappeared from the medium while the cells were growing, but, after stationary phase was reached, no further losses were observed unless pH was maintained above 7.0. Similar losses were observed in a cell-free system if the redox potential of the medium was between -250 and -175 mV. If the disrupted cell suspension was first heated in a boiling water bath for 15-18 min, no NaNO_2 loss was observed regardless of the redox potential. *S. typhimurium* is capable of metabolizing NaNO_2 , possibly by means of a nitrite-reducing enzyme function which is redox controlled. AS

15

N-nitrosation by solid sodium nitrite. Promotion by halocarbon solvents and inhibition by ascorbic acid. Roller, P. P.; Uhm, S. J.; Slavin, B. W.; Keefer, L. K. *Abstracts of Papers, American Chemical Society* 177 (1) AGFD 32 (1979) [En] [Analytical Chem. Section, Lab. of Carcinogen Metabolism, National Cancer Inst., NIH, 37/IE-22, Bethesda, Maryland 20014, USA]

Halocarbons are important industrial solvents and analytical reagents used for extraction of foodstuffs, natural products, and environmental samples. Certain halocarbon solvents react efficiently with secondary amines dissolved in them, giving intermediates which, in the presence of insoluble nitrite, yield N-nitroso compounds. Typically, 0.0024M pyrrolidine and 4-fold molar excess of NaNO_2 in CH_2Cl_2 produced a 50% yield of N-nitrosopyrrolidine after 4.25 days at 25°C . The nitrosamine yield varied with the structure of the starting amine in the order pyrrolidine > piperidine > diethylamine and with the solvent in the order CH_2BrCl > CH_2Cl_2 > $\text{ClCH}_2\text{CH}_2\text{Cl}$ > CF_2Cl_2 > $\text{CCl}_4 \approx \text{CHCl}_3$. With dihalomethanes, the primary nitrosamine-forming mechanism appears to involve initial reaction of solvent with amine, to produce formaldiminium ions ($\text{CH}_2 = \text{NR}_2^+ \text{Cl}^-$), which then react efficiently with nitrite ion, ultimately rearranging to the observed product. The postulated intermediate was also trapped with other nucleophiles, such as cyanide ion or excess amine. Ascorbic acid, potassium iodide and potassium carbonate were found to partially inhibit the overall nitrosation reaction. Possible mechanisms of the inhibitory reactions and the significance of the findings in environmental carcinogenesis will be discussed. AS

16

[Nitrate content of carrots in infant formulas.] Zur Frage Nitratgehalt in Karotten für den Säugling in den ersten Lebensmonaten.

Stolley, H.; Schlage, C.; Droese, W.

Monatszeitschrift für Kinderheilkunde 126 (2) 100-101 (1978) [6 ref. De, en] [Forschungsinst. Kinderernährung, Jägerndorfstrasse 11, D-4600

Dortmund 50, Federal Republic of Germany]

The nitrate contents in 21 samples of fresh and preserved carrots, 5 samples of dietetic carrot juices declared suitable for infants, and 9 special carrot preparations for infants were 40-850, 50-185 and 55-215 $\text{mg NO}_3/\text{kg}$, resp. Some of the dangers of excessive nitrate intake by infants are pointed out, and it is recommended that infants should not be fed with carrots prepared in the household during the first months of life. The validity of the currently accepted safety levels of 250 $\text{mg NO}_3/\text{kg}$ in carrot preparations for infants is questioned. EJM

17

[Flavouring for spring borshch.]

Pilipenko, L. I.; Markh, A. T.; Fel'dman, A. L.; Reznik, M. M.

Konservnaya i Ovoshchesushil'naya Promyshlennost' No. 2, 26-27 (1978) [Ru] [Odesskii Tekh. Inst., Pishchevoi Promyshlennosti imeni M. V. Lomonosova, Odessa, USSR]

A sterilized vegetable flavouring consists of early vegetables (spinach, wood-sorrel, green onions, green parsley and dill). 1 t of mixture contains 372 kg spinach, 138 kg wood-sorrel, 30 kg onions, 30 kg parsley, 30 kg dill, and 400 kg pickle with 3% NaCl , and citric acid. The vegetable flavouring contains 6.92% DM, 0.33 acid (as citric), 1.2% NaCl , and 0.245% total N. A 100 g batch contains 13.62 mg of vitamin C, 2.74 mg carotene, 0.11 mg vitamin B₁, 0.31 mg vitamin B₂, 0.61 mg vitamin B₃, 0.1 mg nitrites; the pH is 3.96. Preparation of the mixture and its sterilization are described. The product can be made e.g. on a tomato juice processing line. Nitrites did not rise during storage if a min. of 0.05% ascorbic or citric acid was added. Nitrites were kept within permissible limits in the product. STI

18

Effect of chloride on nitrate accumulation in papaw (*Carica papaya* L.).

Menary, R. C.; Allan P.

Australian Journal of Plant Physiology 6 (3) 241-247 (1979) [15 ref. En] [Dep. of Agric. Sci., Univ. of Tasmania, Hobart, Tasmania 7001, Australia]

Potassium chloride (2 l) at each of 6 different concn. namely 0, 5, 10, 20, 40 and 80 mm was applied each wk commencing when the rooted cuttings were 9 months old. The concn. of chloride in fruits increased with time in relation to the amount of chloride added. There was an approx. doubling of chloride concn. between the first and last sampling dates. Nitrate contents of papaw fruit in 20, 40 and 80 mm treatments were significantly higher than the controls at the first sampling date. The concn. of nitrate was directly related to the chloride levels at the same sampling date. The difference in nitrate concn. between control and chloride treatments was somewhat magnified at the second sampling date, with all treatments being significantly greater than control. This difference was maintained as fruits developed even though there was a steady decrease in nitrate concn. as fruits matured. VJG

19

[Nitrate content of cheeses sold in Italy.]

Resmini, P.; Volonterio, G.; Prati, F.

Latte 3 (9) 547-552 (1978) [10 ref. It, en] [Istituto di Ind. Agrarie, Univ. degli Studi di Milano, Milan, Italy]

Nitrate was determined in 160 samples of cheese by the Hanni, 2,4-xylenol method. For 15 Italian samples in which it was known that no nitrate had been added, the nitrate content was < 1 mg/kg. Of the other 63 Italian samples, 53 contained < 2 mg/kg, 6 contained 4-10, and 4 contained 12-20 mg/kg. The high values are attributed to fraudulent use of nitrate in cheesemaking or the use of imported curd containing nitrate for the manufacture of, particularly, Mozzarella cheese. Of 28 samples of imported cheese, 6 contained < 2 mg/kg, with values up to 13.7 in German Pasta Filata, to 13.8 in Danish pressed curd, to 49.8 in German Edam, and 59.9 in German Tilsit and 7 mg/kg in Dutch Gouda. Gouda and Samsøe cheeses imported for processing contained 17.5-56.4 mg/kg, but Cheddar contained < 2 . Italian Processed cheese contained 3.11-28.2 mg/kg, with 5.5-13 for German Processed cheese, 1.6-7.4 for French, and 1.02 for a sample from Switzerland. The high values in Processed cheese reflect the nitrate in the cheese being processed and the use of dried whey containing nitrate in the melt. JMD

20

[Method and device for the manufacture of cheese.]

Netherlands, Stichting Bedrijven voor het Nederlandse Instituut voor Zuivelonderzoek

Netherlands Patent Application 7 803 268 (1978) [Nl]

The method concerns the addition of nitrate in cheesemaking. Instead of adding nitrate to the milk or whey, it is injected into the curd immediately after the drainage of the last whey, and before pressing. W&Co

21

Comparison of two methods and improvements for colorimetric determination of nitrite in cod roe.

Ito, Y.; Yodoshi, M.; Tanaka, J.-I.; Iwaida, M.

Journal of Food Protection 42 (9) 715-718 (1979)

[4 ref. En] [Nat. Inst. of Hygienic Sci., Osaka Branch No. 6, Hoenzaka-cho, Higashi-ku, Osaka, Japan]

Attempts were made to develop a sensitive and reproducible method to determine nitrite in cod roe. Two diazotization-coupling reaction methods were considered; (i) the method defined by the Ministry of Health and Welfare of Japan and (ii) the reference method of ISO. Since the nitrite content in cod roe was much less than in meat products, (ii) was modified to make it suitable for microanalysis at 1 p.p.m. level as NO_2 . Modifications included reducing vol. of colour-development solutions and making changes in the colour development process, thus making the colour intensity $4 \times$ as great as before. Carrying out corrections with both reagent and water blanks made the effect of the blank on measured values negligible. Recoveries of nitrite at 20- and 2-p.p.m. levels were 94.7 and 88.1%, resp., reproducibility being $\pm 7.9\%$, as the coeff. of variation. The obtained values by the modified method were, on average, higher than those of the original method by 37.1%. Nitrite contents obtained by

(i) were lower than those by the original (ii). These low values might be attributed to loss of nitrite during extraction from the sample without pH adjustment, since the measured value showed a marked increase on addition of alkaline solution before extraction. Nitrite contents in imported cod roe were within the range 0.16-1.03 p.p.m. expressed as NO_2 . AS

22

Effect of sodium nitrite concentration and packaging conditions on color stability and rancidity development in sliced bologna.

Lin, H.-S.; Sebranek, J. G.

Journal of Food Science 44 (5) 1451-1454 (1979)

[17 ref. En] [Dep. of Anim. Sci., Iowa State Univ., Ames, Iowa 50011, USA]

Colour stability and shelf life of sliced bologna made with various nitrite levels and packaged with different films and vacuum levels were studied. A max. (686-737 mm Hg) initial vacuum level combined with films of low O_2 permeability (7.2 ml/m^2 24 h or less) had higher colour scores, greater cured pigment conversion and lower TBA numbers. A lower nitrite concn. (50 p.p.m.) was possible while maintaining product characteristics if good barrier films ($< 7.0 \text{ ml O}_2/\text{m}^2$ 24 h) and high initial vacuum levels (686-737 mm Hg) were used. IFT

23

Effects of sodium nitrite on *Clostridium botulinum* toxin production in frankfurter emulsions formulated with meat and soy proteins.

Sofos, J. N.; Busta, F. F.; Allen, C. E.

Journal of Food Science 44 (5) 1267-1271 (1979)

[20 ref. En] [Dep. of Food Sci. & Nutr., Univ. of Minnesota, 1334 Eckles Avenue, St. Paul, Minnesota 55108, USA]

Botulinal toxin production, residual nitrite depletion, and total microbial growth were measured in meat and/or soy-containing frankfurter formulations during 27°C temp. abuse. Botulinal toxin production in formulations containing soy proteins was equal to or less rapid than in all-meat samples, both in the absence and presence of nitrite. Of the 9 soy proteins examined, nitrite did not delay *C. botulinum* toxin production in products made from the isolate form, whereas it was an effective control in textured flours and concentrates. In all-meat formulations the effectiveness of nitrite decreased with increasing spore load. Residual nitrite depletion in meat was more rapid than in soy-containing treatments. Among the soy proteins, nitrite depletion was more rapid in the isolate than in the textured form tested. Total microbial growth was similar in both meat and soy-containing samples. Gas production was an inadequate index of toxin development. IFT

24

Reactions of nitrite in meat. [Review]

Cassens, R. G.; Greaser, M. L.; Ito, T.; Lee, M.

Food Technology 33 (7) 46-57 (1979) [143 ref. En]

[Muscle Biol. Lab., Univ. of Wisconsin, 1805 Linden Drive, Madison, Wisconsin 53706, USA]

Formation of nitrosamines during curing and levels

of free nitrite in cured foods have been more extensively reviewed than other reactions of nitrite in meat, about which concerns have been voiced. Background information is provided by this review on chemistry of nitrite; the meat system; the meat curing procedure; general fate of nitrite during curing; reaction with individual meat components – myoglobin, non-haem protein, liquid and carbohydrates; other reactions, such as formation of nitrate, gases, transnitrosation; and inhibition or potentiation of reactions. DIH

25

Botulism control by nitrite and sorbate in cured meats: a review [Review]

Sofos, J. N.; Busta, F. F.; Allen, C. E.
Journal of Food Protection 42 (9) 739–770 (1979)
[300 ref. En] [Dep. of Food Sci. & Nutr., Univ. of Minnesota, 1334 Eckles Avenue, St Paul, Minnesota 55108, USA]

Aspects considered in this comprehensive review include botulism in general; use of sodium nitrite in cured meats (including effects on colour, flavour and rancidity, and nitrosamine formation); relationship between botulism, nitrite and cured meats; and use of sorbate in foods, including in combination with nitrite in cured meats. DIH

26

Reducing of nitrite level in fine cut sausages.

Raseta, J.; Kepcija, D.; Babic, L.; Simovic, D.
Acta Veterinaria, Yugoslavia 28 (2) 81–87 (1978)
[20 ref. En, sh] [Dep. of Meat Hygiene, Fac. of Vet. Med., Univ. of Belgrade, Belgrade, Yugoslavia]

Bologna-type sausages (70% meat, 30% fat) were prepared using nitrite levels of 30, 50, 100 or 150 p.p.m., and stuffed in 97 mm diam. Teepak casings. Composition, flavour and colour of the sausages were evaluated, together with effects of heat treatment or storage at 5°C for ≤ 7 days on residual nitrite concn. Results show that sausages prepared with the nitrite concn. studied did not differ significantly in colour (evaluated subjectively, or by means of the Göfo instrument) or colour stability. Residual nitrite concn. was appreciably reduced by heat treatment of the sausages, and decreased further during subsequent storage. Relation of residual nitrite concn. to pH of the sausages is discussed. No significant effect of nitrite concn. on flavour was observed. AJDW

27

Advances in the technology of nitrite use and consideration of alternatives. [Review]

Sebranek, J. G.
Food Technology 33 (7) 58–62, 93 (1979) [87 ref. En]
[Dep. of Anim. Sci. & Food Tech., Iowa State Univ., Ames, Iowa 50011, USA]

Modifications in processing and handling of cured foods to reduce nitrite content, and potential substitutes for nitrite are reviewed. Use of ascorbate or erythorbate enhances protective effects of nitrite against *Clostridium botulinum*, whilst reducing residual nitrite. Action of ascorbate is potentiated by EDTA. Other aspects of formulation change include use of acidulants

or lactic starter cultures, and smoking. Product composition, such as bacon fat level, may be made more uniform by trimming; temp. of pumping and smokehouse cycles may all be controlled. Potential substitutes for nitrite that have been studied include natural beet pigments, *S*-nitrocysteine, preservation by irradiation, or use of nitrosamine inhibitors in combination with nitrite. Inhibitors of *C. botulinum*, such as sorbate, used in conjunction with low levels of nitrite seems to be a viable alternative to use of nitrite alone, but further research is still needed. DIH

28

Nitrite and nitrosamine update. (In 'Proceedings of the 31st Annual Reciprocal Meat Conference' (see FSTA (1980) 12 2S230)) [Lecture]

Wasserman, A. E.
pp. 121–128 (1979) [En] [E. Reg. Res. Cent., Fed. Res., Sci. & Education Administration, USDA, 600 East Mermaid Lane, Philadelphia, Pennsylvania 19118, USA]

Aspects discussed include: analytical techniques; nitrosamine concn. in foods; nitrosamines in non-food sources; possible in-vivo formation of nitrosamines from nitrites and amines; human and animal studies on formation of nitrosamines in the digestive tract; the current legal status of use of nitrite in cured meat products; possible substitutes for nitrite in cured meat products (with special reference to control of *Clostridium botulinum*); nitrosation inhibitors; carcinogenicity of nitrosamines; and possible consequences of banning nitrites. AJDW

29

The role and mechanism of the inhibition of *C. botulinum* by nitrite – is a replacement available? (In 'Proceedings of the 31st Annual Reciprocal Meat Conference' [see FSTA (1980) 12 2S230]) [Lecture]

Tompkin, R. B.
pp. 135–147 (1979) [22 ref. En] [Swift & Co., Res. & Development Cent., 1919 Swift Drive, Oak Brook, Illinois 60521, USA]

Studies on the mechanism of inhibition of clostridia by nitrite in cured meat products are discussed on the basis of literature data. Diagrams are given showing effects of nitrite, isoascorbate, ascorbate, cysteine, Na₂S, antioxidants, EDTA and haemoglobin on inhibitory activity. Loss of inhibitory activity with increasing storage time of the cured product is also considered, together with the inverse relationship between degree of pigmentation of meat and efficacy of nitrite for inhibition of clostridia. The hypothesis that available Fe in meat negates the inhibitory activity of nitrite is discussed; this hypothesis is consistent with differences in inhibitory activity of nitrite in different meat products, and observed enhancement of inhibitory activity of nitrite by chelating agents. It is suggested that the inhibitory activity of nitrite may be due to reaction of nitric oxide with an Fe-containing compound within the vegetative clostridial cell. The potential for substitution of other *Clostridium botulinum* control agents for nitrite is discussed. AJDW

30

Effect of packaging conditions, nitrite concentration, sodium erythorbate [erythorbate] concentration and length of storage on color and rancidity development of sliced bologna.

Lin, H.-S.

Dissertation Abstracts International, B 39 (10) 4798: Order no. 79-07260, 115pp. (1979) [En] [Iowa State Univ., Ames, Iowa 50010, USA]

Studies on effects of nitrite level, erythorbate level and packaging on colour stability and shelf-life (rancidity development) of sliced Bologna sausage are described. High initial vacuum level, in conjunction with packaging in film of low O₂ permeability, gave slightly lower TBA value, higher colour score and greater cured pigment conversion than packaging with a low initial vacuum level. If high initial vacuum level and a low O₂ permeability packaging film were used, good product characteristics could be maintained even if a relatively low nitrite level (50 p.p.m.) was used. High level (≥ 500 p.p.m.) of erythorbate improved colour, and retarded development of rancidity during storage of sliced packaged Bologna sausage. AJDW

31

Processing of poultry products with and without sodium nitrite.

Bauermann, J. F.

Food Technology 33 (7) 42-43 (1979) [En] [Horace W. Longacre, Inc., Box 8, Franconia, Pennsylvania 18924, USA]

Some types of poultry products, processed with or without nitrite to give longer shelf-life than raw meat, and the processes involved are discussed. Use of citric acid as pH control with or without HTST treatment gives a product with a shelf life of 10-16 wk at $<4.4^{\circ}\text{C}$. 'Thermoplastic' products are mixtures of cooked ingredients and binders stuffed into casings and pasteurized; products are sold sliced and vacuum-packed with shelf lives of approx. 6 wk at $<4.4^{\circ}\text{C}$. 'Thermoset' products include items such as roasted turkey rolls and boneless cooked breasts, and are sold in bulk vacuum packaging, often frozen. Smoked, cured nitrite-containing products are made with 136-156 μg sodium nitrite/g product, and include items such as poultry frankfurters. Combination poultry/red meat products exist in which only the other meat (e.g. bacon) contains nitrite. Sensory analysis results of nitrated vs. non-nitrated products are inconclusive, but nitrite does provide improved shelf-life. Use of sorbic acid as an alternative to nitrite has produced less acceptable flavour in products. DIH

32

[Analysis of meat and meat products. Determination of nitrite. Reference method.] Untersuchung von Fleisch und Fleischerzeugnissen. Bestimmung des Nitritgehalts. Referenzverfahren.

Germany, Federal Republic of, Deutscher Normenausschuss

German Federal Republic Standard DIN 10 148, 3pp. (1978) [De]

A reference method for detn. of nitrite in meat products is described, based on preparation of a hot

water extract of the product under test, elimination of protein from the extract by precipitation and filtration, detn. of nitrite in the resulting solution by the sulphanilamide/*N*-[naphthyl-(1)]ethylenediammonium dichloride method (optical density measurement at 540 nm) and calculation of the nitrite concn. in the sample on the basis of reference curves. AJDW

33

[Analysis of meat and meat products. Determination of nitrate. Reference method.] Untersuchung von Fleisch und Fleischerzeugnissen. Bestimmung des Nitratgehalts. Referenzverfahren.

Germany, Federal Republic of, Deutscher Normenausschuss

German Federal Republic Standard DIN 10 147, 4pp. (1978) [De]

A reference method for detn. of the nitrate content of meat products is described, based on preparation of a hot-water extract of the sample, separation of protein from the extract by precipitation and filtration, conversion of nitrate to nitrite by means of a Cd column, detn. of nitrite in the reduced solution by the sulphanilamide/*N*-[naphthyl-(1)]ethylenediammonium dichloride method (optical density measurement at 540 nm), calculation of nitrate concn. in the sample by means of reference curves, and correction for nitrite present in the sample before reduction. AJDW

34

[Comparative determination of nitrate in foods by various methods. Colorimetry, gas chromatography, thin layer chromatography, potentiometry.]

Vergleichende Bestimmung der Nitratgehalte von Lebensmitteln mit Hilfe verschiedener Methoden. Kolorimetrie - Gaschromatographie - Dünnschichtschromatographie - Potentiometrie. Müller, H.; Siepe, V.

Deutsche Lebensmittel-Rundschau 75 (6) 175-183 (1979) [17 ref. De, en, fr] [Inst. für Forschung & Entwicklung, Maizena GmbH, D-7100 Heilbronn (Neckar), Federal Republic of Germany]

Comparative studies were conducted on detn. of nitrate in foods for infants, by (i) the xylenol colorimetric method, (ii) GLC on a 5% OV 17 on Varaport 30 80/100 mesh column with flame ionization detection, (iii) TLC on silica gel 60 using a toluene/petroleum ether (1:1) solvent system, or (iv) potentiometry, using an Orion type 93-07 nitrate-specific electrode system. Comparative studies were conducted by methods (i), (ii) and (iii) on samples of fruit purees, dried fruit products, cereal products, and dairy products (dried skim milk, dried whey, dried milk preparations); the results show values determined by (ii) and (iii) to agree well, but values determined by (i) to be considerably higher (by a factor of ≤ 40). This is attributed to the presence of volatile carbohydrate degradation products, interfering with photometric detn. of nitrate. The % recovery of nitrate was 83-105% for (i), 100-108% for (ii), and 84-108% for (iii). Studies were conducted by all 4 methods on samples of spinach, carrots, and spinach and carrot products. Results for spinach showed close agreement of values determined by (i), (ii) and (iii); results for spinach products and for

carrots and carrot products showed good agreement between (ii) and (iii), but relatively poor agreement of (i) with (ii) or (iii), probably as a result of the higher carbohydrate concn. in these products. Method (iv) gave values up to 5% higher than those determined by the other methods. The relative merits and applications of the 4 methods studied are discussed. AJDW

35

Determination of nitrate in raw, potable and waste waters by ultraviolet spectrophotometry.

Rennie, P. J.; Sumner, A. M.; Basketter, F. B.

Analyst 104 (1242) 837-845 (1979) [12 ref. En] [N. W. Water Authority, Southern Div., Allport Road/Bridle Road, Bromborough, Wirral, Merseyside, L62 6AB, UK]

The method uses an activated carbon filter at an elevated pH which eliminates interference from organic matter, i.e., substances commonly assumed to be responsible for the related absorbances at 275 and 210 nm. The procedure also removes interferences of several cations that are precipitated out of solution. The method has a limit of detection of 0.006 mg N/l and a total s.d. of 0.016 mg N/l at a nitrate concn. of 1.05 mg N/l in potable water. No statistically significant difference was detected between the proposed method and an established automated method for a wide range of samples. AS

36

[Nitrate and nitrite in horticultural products. VIII. Nitrate and nitrite contents in Japanese radish and changes during growing, storage and pickling.]

Hata, A.; Ogata, K.

Journal of Japanese Society of Food Science and Technology [Nippon Shokuhin Kogyo Gakkaishi] 25 (5) 280-286 (1978) [9 ref. Ja, en] [Fac. of Living Sci., Kyoto Prefectural Univ., Simogamo, Kyoto, Japan]

When a spring, summer and a winter var. of Japanese radish were stored at 1° and 20°C, no changes in nitrate contents occurred in the first 2, but nitrate concn. decreased slightly in the winter var. Nitrate reductase activity remained at a low level during storage. Pickling in salt-bran led after 26 days to equilibrium between the roots and the salt-bran; max. content of nitrite was only 0.4 p.p.m. Pickling in salt only led to changes in nitrate contents in the roots and in brine similar to those found with salt-bran. Nitrite contents were max. 3 days after start of pickling at 20°C (30 p.p.m. in root and 230 p.p.m. in brine); at 6°C, formation of nitrite was suppressed markedly. [From En summ.] HBr

37

[Comparison of methods for determination of nitrate in cured meats.]

Czegledi-Janko, G.

Husipar 27 (5) 230-233 (1978) [7 ref. Hu, en, de, ru] [AHT Minősegellenőrzési Osztalya, Soroksari út 58, 1095 Budapest, Hungary]

Comparative studies were conducted on detn. of nitrate in cured meat products by (i) the Cd-column method specified in Hungarian standard MSZ 6905, and by (ii) the nitrosalicylic acid method of Selmečı et al.

[*Elelmiszervizsgalati Közlemenyek* (1975) 21, 187-194]. A table of data is given for nitrate concn. determined by these 2 methods in samples of 26 cured meat products. The results show that, above nitrate concn. of 200 mg/kg, the results determined by (i) and (ii) differ very little (correlation coeff. $r = 0.9981$). Method (i) is more sensitive, but this is of little significance for monitoring for compliance with food standards. The simplicity and rapidity of method (ii) are advantageous for routine quality control. AJDW

38

Sodium nitrite and sorbic acid effects on *Clostridium botulinum* spore germination and total microbial growth in chicken frankfurter emulsions during temperature abuse.

Sofos, J. N.; Busta, F. F.; Allen, C. E.

Applied and Environmental Microbiology 37 (6) 1103-1109 (1979) [24 ref. En] [Dep. of Food Sci. & Nutr., Univ. of Minnesota, St. Paul, Minnesota 55108, USA]

Samples of (i) a control or of (ii) sodium nitrite-containing or (iii) sorbic acid-containing, mechanically deboned chicken meat frankfurter-type emulsion inoculated with *Clostridium botulinum* spores, or a combination of (ii) and (iii), were temp. abused at 27°C. Spore germination and total microbial growth were followed and examined at specified times and until toxic samples were detected. The spores germinated within 3 days in both control and nitrite (20, 40, and 156 µg/g) treatments. Sorbic acid (0.2%) alone or in combination with nitrite (20, 40, and 156 µg/g) significantly ($P < 0.05$) inhibited spore germination. No significant germination was recorded until toxic samples were detected. A much longer incubation period was necessary for toxin to be formed in nitrite-sorbic acid combination treatments as contrasted with controls or nitrite and sorbic acid used individually. Total growth was not affected by the presence of nitrite, whereas sorbic acid appeared to depress it. Possible mechanisms explaining the effects of nitrite and sorbic acid on spore germination and growth are postulated. AS

39

[Determination of nitrite and nitrate in meat.]

Barbieri, G.; Sala, G.; Gavioli, E.; Beneventi, G.

Bollettino dei Chimici dei Laboratori Provinciali 5 (4) 611-616 (1979) [8 ref. It, de, en, fr] [Lab. Chimico Provinciale, Via Fontanelli 21, 41100 Modena, Italy]

A quick method was developed for simultaneous detn. of NO_2^- and NO_3^- additions to meat. NO_2^- is determined by diazotization, and NO_3^- by reaction with chromotropic acid after passage on a AG 3 × 4 chromatographic column. Interference of NO_2^- in the NO_3^- detn. was prevented by adding sulphanilic acid, which prevents its reaction with chromotropic acid. RM

40

Acceptability of smoked turkey drumsticks with and without nitrite addition.

Olson, V. M.; King, N. A.; Langbehn, J. A.; Stadelman, W. J.

Poultry Science 58 (3) 587-590 (1979) [10 ref. En]

[Anim. Sci. Dep., Purdue Univ., W. Lafayette, Indiana 47907, USA]

2 methods of preparing smoked turkey drumsticks were compared as to consumer acceptance. Smoking and cooking methods were the same; however, one brine solution contained nitrite (Product A) and the other did not (Product B). Consumers were asked to rate both products for colour, appearance, flavour, and tenderness as follows: 1 – very good; 2 – good; 3 – fair; 4 – poor. They were also asked: which product do you like best?, which product would you buy?, and what is your opinion on the nitrite-nitrate controversy? Results indicated 65% preferred Product A, 31% Product B, and 4% both products. Results on buying indicated 58% would buy Product A, 28% Product B, 7% both, and 7% neither. Ratings for colour were: Product A 1.6, Product B 2.3 ($P < 0.01$); appearance: Product A 1.8, Product B 2.3 ($P < 0.01$); flavour: Product A 1.8, Product B 2.1 (non-significant); tenderness: Product A 1.8, Product B 2.0 (non-significant). Responses to the nitrite-nitrate question varied greatly from 'needed to prevent food poisoning' to 'against the use of nitrite'. The drumsticks had a 20% shrinkage loss which occurred during smoking and cooking. Drumsticks were priced at \$25.00/cwt, brine cost was \$4.12/cwt, and total cost was \$29.12/cwt for meat and brine. This resulted in an investment of 36.4c/lb of cured-cooked product. AS

41

The mutagenicity of soy bean sauce.

Lin, J. Y.; Wang, H.-I.; Yeh, Y.-C.

Food and Cosmetics Toxicology 17 (4) 329–331 (1979) [15 ref. En] [Inst. of Biochem. Coll. of Med., Nat. Taiwan Univ., Taipei, Taiwan]

Soy sauce is commonly used as a food material in Taiwan where the incidence of hepatoma and gastric cancer is high. Samples of 21 different brand names of soy sauce, bought from the local stores in Taipei City, were treated with or without sodium nitrite at pH 3 and 5 strains TA98, TA100, TA1535, TA1537 and TA1538 of histidine requiring auxotrophs of *Salmonella typhimurium*. All brands contained an unknown substance which reacted to form a compound of the alkyl nitrosoareido type by nitrosation in vitro. The mutagenic activity of the resulting compound was revealed using the above strains of *S. typhimurium* that are susceptible to base-pair-substitution. Most mutagenic material was formed when the nitrite level was 2000 p.p.m. and the pH was 3; ascorbic acid prevented the formation of mutagenic products in nitrite-treated soy sauce. VJG

42

[Nitrosamines and foods.] Nitrosamine und Lebensmittel. [Review]

Anon.

Schlachten und Vermarkten 78 (8) 242–245 (1979) [20 ref. De, en, fr]

This review discusses the carcinogenic properties of nitrosamines, their formation (role of NO_2^- , NO_3^- and amines), presence of nitrosamines in foods, reduction of NO_2^- in meat curing salt, and health hazards under existing food habits. Comprehensive studies in the USA suggest no cancer risk during normal lifespan. RM

43

Action of sodium nitrite on folic acid and tetrahydrofolic acid.

Reed, L. S.; Archer, M. C.

Journal of Agricultural and Food Chemistry 27 (5) 995–999 (1979) [28 ref. En] [Dep. of Nutr. & Food Sci., Massachusetts Inst. of Tech., Cambridge, Massachusetts 02139, USA]

Folic acid reacted with NaNO_2 in dilute aqueous solution at both pH 1.5 and 5.0 to yield exclusively N^{10} -nitrosofolic acid. At pH 1.5, the reaction was 2nd order in nitrite, but at pH 5.0, the order in nitrite was one, and buffer anions participated in the nitrosation reaction. Tetrahydrofolic acid was rapidly oxidized by NaNO_2 at both pH 1.5 and 5.0 to produce *p*-amino-benzoylglutamate and several pterin products. Ascorbate had a protective effect on the oxidation of tetrahydrofolate by nitrite at pH 5.0, but even when ascorbate was in 100-fold excess, tetrahydrofolate oxidation was not completely inhibited. 5-Methyl-tetrahydrofolate was oxidized by nitrite at pH 5.0 to produce several pterin products. 5-Formyl-tetrahydrofolate reacted with NaNO_2 at pH 5.0 to yield a single product which was probably the N^{10} -nitroso derivative. AS

44

Concentration of nitrate in normal human urine and the effect of nitrate ingestion.

Radomski, J. L.; Palmiri, C.; Hearn, W. L.

Toxicology and Applied Pharmacology 45 (1) 63–68 (1978) [13 ref. En] [Dep. of Pharmacology, School of Med., Univ. of Miami, Miami, Florida 33152, USA]

When volunteers were fed a diet free from vegetables and preserved meats with low-nitrate (<1 p.p.m.) drinking water, urinary nitrate concn. was 10–30 p.p.m.; when this diet was consumed with high nitrate (40 p.p.m.) drinking water, urinary nitrate concn. rose to 34–87 p.p.m. A diet containing raw and cooked vegetables previously reported as containing high nitrate levels (e.g. broccoli, spinach, lettuce, tomatoes, cauliflower, collard greens) resulted in urinary nitrate concn. of 270–425 p.p.m. On the basis of the results obtained, it is concluded that nitrates in vegetables constitute a more important source of urinary nitrate than nitrates in drinking water. JA

45

Nitrites and bacteria in fresh carrot juice made from roots stored at high temperatures.

Hall, C. B.; Stall, R. E.; Hicks, J. R.

HortScience 13 (6, section 1) 687–688 (1978) [5 ref. En] [Inst. of Food & Agric. Sci., Univ. of Florida, Gainesville, Florida 32611, USA]

Juice made from carrots stored at 20, 25, 30 or 35°C for 0, 2, 4 or 8 days contained negligible amounts of nitrite when sampled immediately. The bacterial populations were higher in juice made from carrots stored for longer periods and at the higher temp. Juices incubated at 35°C for 4 h accumulated nitrite in amounts that tended to correspond to the bacterial populations in the fresh juices. AS

46

[Problem of nitrite and nitrate in vegetables, particularly spinach. I. Influence of nitrogen fertilization and processing on frozen spinach.] Zum Problem des Nitrat- und Nitritgehaltes bei Gemüse, insbesondere Spinat. I. Einfluss der Stickstoffdüngung und der Verarbeitung zu Gefrierspinat.

Acar, Y.; Ahrens, E.

Chemie Mikrobiologie Technologie der Lebensmittel 5 (6) 170-174 (1978) [29 ref. De, en, fr] [Inst. für landwirtschaftliche Mikrobiologie der Justus-Liebig-Universität, Giessen, Federal Republic of Germany]

Numbers of bacteria on leaves of spinach fluctuated between 0.3 and 100 million/g, depending on harvest dates and intensity of N-fertilization. Thus, the highest count was found on leaves growing closest to the soil and resulted from doses of 200 or 100 kg N/ha, depending on harvest date. A dose of 400 kg N/ha had a clearly detrimental effect both on the plant and on the bacteria. At ≤ 200 kg N/ha, the NO_3 content in the plant considerably increased; beyond this amount, it slightly decreased. The max. increase, compared with non-fertilized soil, averaged 5089%. It was noted, however, that the organic N concn. of spinach increased up to 400 kg N/ha, but in total only by about 35%. Blanching reduced the bacterial count to 3.4 and 0.41%, the quantity of NO_3 to 36.4 and 35.2% and the concn. of NO_2 to 32.7 and 24.8% of the original levels, for 100 and 200 kg N/ha, resp. In the subsequent freezing procedure, the corresponding values decreased as follows: bacterial count down to 0.17 and 0.03%; concn. of NO_3 , to 30 and 25%; and concn. of NO_2 , to 30.7 and 16.7%. AS

47

[Problem of nitrite and nitrate in vegetables, particularly spinach. II. Influence of long-term storage in an in-store deep freeze cabinet.] Zum Problem des Nitrat- und Nitritgehaltes bei Gemüse, insbesondere Spinat. II. Einfluss einer Langzeitlagerung in der Laden-Tiefgefriertruhe.

Acar, Y.; Ahrens, E.

Chemie Mikrobiologie Technologie der Lebensmittel 5 (6) 175-178 (1978) [14 ref. De, en, fr] [Inst. für landwirtschaftliche Mikrobiologie der Justus-Liebig-Universität, Giessen, Federal Republic of Germany]

NO_3 and NO_2 concn. on 22 different commercial packs of frozen vegetables (spinach, endives, beans, broad beans, parsley, mixed apple/red cabbage, peas, cauliflower) were 0-2234 and 0.5-22.5 mg/kg fresh substance (FS), resp. In 15 of the packs, the amount of NO_3 /kg FS was almost 2-7 \times the recommended max. value. Due to the principle of twice a day defrosting in the automatic cabinet the package temp. became higher than -18°C for a period of about 9 h, of which about 12 min were on average -9.8°C . After 24 wk frozen storage, the number of bacteria had been reduced to an average of 25.3% of the initial count. At this level, the rate of decrease in bacterial count in the in-store cabinet was 35% greater than that in a normal freezer. By contrast, the amounts of NH_4 , NO_3 and NO_2 remained unchanged throughout the duration of this experiment in both types of equipment. Thus, microbial-induced changes in a deep freeze cabinet are excluded. [See preceding abstr. for part I.] HBr

48

[Problem of nitrite and nitrate in vegetables, particularly spinach. III. Bacteria counts and formation of nitrite in relation to temperature.] Zum Problem des Nitrat- und Nitritgehaltes bei Gemüse, insbesondere Spinat. III. Keimzahlen und Nitritbildung in Abhängigkeit von der Temperatur.

Acar, Y.; Ahrens, E.

Chemie Mikrobiologie Technologie der Lebensmittel 5 (6) 179-182 (1978) [5 ref. De, en, fr] [Inst. für landwirtschaftliche Mikrobiologie der Justus-Liebig-Universität, Giessen, Federal Republic of Germany]

In an in-store deep freeze cabinet incorrectly adjusted to temp. between -10°C and $+10^\circ\text{C}$, the bacterial count was reduced to a greater extent than in a normal deep-freeze cabinet with a constant temp. of -18°C . The amount of soluble N however did not change. In thawed spinach packs a considerable increase in the bacterial count and NO_2 concn. at $+20^\circ\text{C}$ was observed after only 1 day, but at 4°C only after 1 wk. In nitrate broth the NO_2 concn. increased between 0° and $+55^\circ\text{C}$; the highest quantity was reached at $+40^\circ$ and $+55^\circ\text{C}$ after 1 day, at $+30^\circ\text{C}$ after 2 days, at $+20^\circ\text{C}$ after 5 days, and at $+10^\circ$ and $+5^\circ\text{C}$ after about 28 days. At 0°C , the quantity of NO_2 was only about 1/3 of that at $+10^\circ\text{C}$ and almost 1/2 that at $+5^\circ\text{C}$. [See preceding abstr. for part II.] AS

49

Nitrate contents of kohlrabi (*Brassica oleracea* L. var. *gongylodes* Lam.) as influenced by fertilization. [Lecture]

Venter, F.; Fritz, P. D.

Qualitas Plantarum - Plant Foods for Human Nutrition 29 (1) 179-186 (1979) [14 ref. En, de] [Lehrstuhl für Gemüsebau, Tech. Univ. München, D-8050 Freising-Weihenstephan, Federal Republic of Germany]

Studies were conducted on the kohlrabi var. Trero to evaluate effects of fertilizer treatments on nitrate concn. 2 greenhouse trials were carried out with a uniform level of N fertilizer (100 kg N/ha) from 4 N sources: $\text{Ca}(\text{NO}_3)_2$, $(\text{NH}_4)_2\text{SO}_4$, CaCN_2 , and Crotodur. 2 field trials were conducted, the above 4 N sources being used at 3 levels (10, 100 or 200 kg N/ha). Tables and block diagrams of data are given for nitrate concn. in kohlrabi grown under these various N fertilizer treatments. Nitrate content increased with increasing level of N fertilizer addition. At equal applied N levels, $\text{Ca}(\text{NO}_3)_2$ gave the highest and CaCN_2 the lowest nitrate concn. in the tubers in field experiments. In greenhouse trials, it was observed that type of N fertilizer had little effect on the nitrate concn. in the tubers. At equal applied N concn., greenhouse-grown kohlrabi had considerably higher nitrate concn. than field-grown kohlrabi. Nitrate content of the tubers decreased with increasing time between final application of N and harvesting. [See FSTA (1980) 12 4A203.] AJDW

50

[Nitrite test for quality assessment of milk deliveries.] Zagaevskii, I. S.

Molochnaya Promyshlennost' No. 2, 40-41 (1979) [Ru] [Belotserkovskii Sel'skokhoz. Inst., Belaya Tserkov, USSR]

'Nitrin-6', consisting of 30 g glucose, 20 g NaNO_3 , 5 g K_2HPO_4 , 0.8 g resorcinol and 0.005 g Chinosol (hydroxyquinoline sulphate), dissolved in 1 l distilled water at pH 7.6–7.7, is recommended as reagent for rapid detection of the presence of *Escherichia coli* in milk deliveries, through specific formation of nitrite in milk incubated at 44°C with 'Nitrin-6'. Six 5 ml samples of the milk under test and 1 ml 'Nitrin-6' are incubated at 44°C for 10, 30, 40, 50 min and 1 and 2 h, resp.; at the end of incubation, 3–4 drops of 10% solution of Griess reagent [sulphanilic acid and α -naphthylamine in acetic acid] are added along the inner wall of each sample tube together with 'Nitrin-6' (proportions not stated), avoiding mixing with milk. Appearance of a pink or red stripe indicates the presence of *E. coli*, the numbers (ranging from 0.3 to 100 000/ml) depending on rate of colour appearance. SKK

51

***Clostridium botulinum* control by sodium nitrite and sorbic acid in various meat and soy protein formulations.**

Sofos, J. N.; Busta, F. F.; Allen, C. E.

Journal of Food Science 44 (6) 1662–1667, 1671 (1979) [En] [Dep. of Food Sci. & Nutr., Univ. of Minnesota, 1334 Eckles Avenue, St. Paul, Minnesota 55108, USA]

Clostridium botulinum inoculated frankfurter-type mixtures formulated with different meats (mechanically deboned chicken meat, beef, and pork) and/or soy proteins (textured, concentrate and isolate) were incubated at 27°C. Effects of NaNO_2 and/or sorbic acid on botulinal spore germination, outgrowth, and toxin production were determined at specified time intervals during the incubation period. Also, residual nitrite depletion and in some instances total microbial growth were measured. Sorbic acid alone (0.2%) or in combination with nitrite (80 $\mu\text{g/g}$) retarded spore germination and outgrowth, and delayed toxin production. These effects were greater in mixtures formulated with both nitrite and sorbic acid and were greater in beef, pork, and soy protein than in mechanically deboned chicken meat. Nitrite (80 $\mu\text{g/g}$) alone was only slightly effective in delaying toxin production and of significance only in pork. The highest nitrite level (156 $\mu\text{g/g}$) tested in meat/soy mixture was significantly inhibitory to toxin development. Botulinal germination, outgrowth, and toxin production were slower in all-soy, control (nitrite/sorbic acid-free) formulations than in all-meat, control samples. Residual nitrite depletion was slower in soy formulations, especially of the textured form, compared to all-meat treatments. Inclusion of nitrite and/or sorbic acid in the formulation did not significantly change the rate and extent of total microbial growth in meat-soy formulations. IFT

52

High doses of nitrate in rations for milk-fed calves. I. Effect on zootechnical characteristics, methemoglobin formation and nitrate and nitrite in some organs.

Berende, P. L. M.; Terluin, R. W.; Wai, P. van der
Zeitschrift für Tierphysiologie, Tierernährung und

Futtermittelkunde 42 (6) 312–321 (1979) [20 ref. En, de] [Inst. for Anim. Nutr. Res., Wageningen, Netherlands]

60 Dutch Friesian bull calves (initially 10 wk of age, average live wt. approx. 84 kg) were used in a study on effects of dietary NO_3^- concn. (20, 420, 2040, 5520 or 10 060 p.p.m.) on performance, carcass quality, and NO_3^- concn. in various organs. During the 9 wk pre-test period, the calves received a diet with 950 p.p.m. NO_3^- for the first 7 wk, and one with 18 p.p.m. for the final 2 wk. During the 8 wk test period, the calves received the experimental diets. The calves were fed either the experimental diets or an 18 p.p.m. NO_3^- control diet until slaughter 0–3 wk after the end of the test period. No significant effects of dietary NO_3^- concn. on the carcass quality characteristics studied (dressing %, meatiness score, colour score, carcass class score, and wt. and % liver, kidney, and spleen) were observed. NO_3^- concn. of the blood, liver, kidney and muscle increased with increasing dietary NO_3^- concn., the tissue NO_3^- concn. for the 10 060 p.p.m. NO_3^- diet being 245 mg/kg for blood, 18.2 mg/kg for kidney, and 65 mg/kg for muscle and liver. NO_2^- concn. in these tissues was not significantly influenced by dietary NO_3^- concn. Addition of zinc bacitracin or furazolidone to the 10 060 p.p.m. NO_3^- diet had no significant affect on tissue NO_2^- or NO_3^- concn. AJDW

53

[Use of nitrite and nitrate in Finnish meat products.]

Ruusunen, M.; Puolanne, E.; Niinivaara, F. P.

Suomen Eläinlääkärilehti 84 (5) 271–280 (1978)

[22 ref. Fi, en] [Helsingin Yliopiston Lihateknologian Laitos, Finland]

In Finland addition of nitrite to meat products is permitted in the form of a 10% solution and as a 0.6% mixture with NaCl so as to give max. permitted nitrite content of 150 mg NaNO_2/kg in final product. The product is allowed to contain 500 mg NaNO_3/kg . Combined use of nitrite and nitrate is permitted, but the sum of the % shares calculated from their maximal permitted amounts may not exceed 100%. According to an industry survey carried out in 1975, to which 25 companies responded out of a total of 38, a max. of 150 mg nitrite/kg was generally added to meat products. In many cases relatively large amounts of nitrate were added, over 400 mg KNO_3/kg . In dry sausage, the use of nitrite and nitrate together was also common, and in these cases nitrate was used in rather large amounts. Analysis of nitrite content of 1109 samples showed an average of <0.5 the max. amount permitted in final products, and in only 1 sample was it exceeded. Based on literature and this analysis, it was decided to recommend max. concn. of 120 mg NaNO_2/kg in cooked sausage and 200 mg KNO_3/kg in dry sausage. In dry sausage it is also possible to use a mixture of the 2, e.g. 60 mg NaNO_2 + 100 mg KNO_3/kg . Use of nitrate is appropriate only when pure bacterial cultures are employed. If reduced amounts of nitrite and nitrate are used, a high hygienic standard is required at all stages of manufacture and storage, and in the case of dry sausage, use of starter cultures or glucono- δ -lactone as well, in order to ensure a sufficiently rapid fall in pH. AS

54

The role of nitrite in preventing development of warmed-over flavour.

Fooladi, M. H.; Pearson, A. M.; Coleman, T. H.; Merkel, R. A.

Food Chemistry 4 (4) 283-292 (1979) [18 ref. En] [Michigan State Univ., E. Lansing, Michigan 48824, USA]

Development of warmed-over flavour (WOF) was followed in samples of beef, pork, and chicken with and without added NO_2^- (156 p.p.m.). Samples were evaluated by the 2-thiobarbituric acid (TBA) test and by sensory panel scores before and after cooking, and after 48 h at 4°C. Added NO_2^- inhibited WOF development in raw beef and chicken and in cooked meat, resulting in a 2-fold reduction in TBA values for cooked beef and chicken and a 5-fold reduction in pork. Sensory panel scores confirmed the protective effect of added NO_2^- in meat from all 3 spp. Total lipid levels were not significantly related to WOF, but there was evidence for involvement of phospholipids. AS

55

[Effect of sulphite on nitrite analyses in meat products.]

Kaaber, L.

NINF Informasjon No. 5, 31-32 (1979) [No]

A brief account is given of tests carried out at the Norsk Institutt for Naeringsmiddelforskning (Norway) to determine whether presence of sulphite could interfere with analysis of nitrite in meat products. Results showed that interference occurred, but at a level that was of no practical significance in the analysis of meat products for nitrite contents. HBr

56

[The effect of trisodium citrate on reddening and nitrite content of cooked cured meat.] Der Einfluss von Trinatriumcitrat auf Umrötung und Nitritgehalt bei gegartem, gepökeltem Fleisch.

Scheid, D.; Lordt, M.

Fleischwirtschaft 59 (7) 903-904, 907-908; 972 (1979) [8 ref. De, en] [L. Scheid GmbH, Postfach 50, 6621 Überhahn/Saar, Federal Republic of Germany]

The effect of adding 2% trisodium citrate (TSC) and/or 0.1% sodium ascorbate (NaA) at pH 7.3 and 9.0 with the NO_2^- curing salt on the reddening and NO_2^- contents of cooked cured meat products was investigated. Tabulated results showed that TSC had no significant effect on reddening. NaA caused some increase in reddening, both alone and in conjunction with TSC. Both additives reduced residual NO_2^- to about the same extent, and produced a highly significant reduction when used together (from 90.9 to 78.8 mg/kg at pH 7.3 or 79.9 at pH 9.0). RM

57

[Effects of recent research results on the nitrate/nitrite/nitrosamine problem in meat products.] Welche Konsequenzen ergeben sich für Fleischerzeugnisse aus den bisherigen Ergebnissen zum Nitrat/Nitrit/Nitrosamin-Problem? [Review]

Leistner, L.

Fleischwirtschaft 59 (10) 1415, 1416, 1418-1422, 1425-1427 (1979) [many ref. De] [Bundesanstalt für Fleischforschung, 8650 Kulmbach, Federal Republic of Germany]

In answer to a reader's enquiry, recent research on effect of $\text{NO}_2^-/\text{NO}_3^-$ additions to meat products is reviewed with reference to formation of carcinogenic nitrosamines, and inhibition of *Clostridium botulinum*. Attention is also given to the high contribution of vegetable products (especially from high N fertilization) and beer (64% of total intake for German male adults, vs. 10% from cured meats), and to endogenously produced NO_2^- (about 15% of daily load in saliva, 82% formed by intestinal flora). There is at present no practical substitute for $\text{NO}_2^-/\text{NO}_3^-$ meat curing salt for inhibition of *Cl. botulinum*. RM

58

Influence of pH on *Clostridium botulinum* control by sodium nitrite and sorbic acid in chicken emulsions.

Sofos, J. N.; Busta, F. F.; Allen, C. E.

Journal of Food Science 45 (1) 7-12 (1980) [En] [Dep. of Food Sci. & Nutr., Univ. of Minnesota, 1334 Eckles Avenue, St. Paul, Minnesota 55108, USA]

Influence of H^+ concn. on the effectiveness of NaNO_2 and/or sorbic acid to control *Clostridium botulinum* growth during elevated temp. abuse (27°C) of mechanically deboned chicken meat frankfurter-type emulsions was examined. Toxin production, spore germination (loss of heat resistance) and outgrowth, residual nitrite levels, and total microbial growth (aerobic colony forming units) were determined at specified times during the incubation period. The effect of sorbic acid (0.2%), alone or in combination with nitrite (40, 156 µg/g), in significantly ($P < 0.05$) inhibiting spore germination, growth, and toxin production was pH dependent. This effect was not observed at pH values > 6.20 and it increased with decreasing pH. Inclusion of nitrite in the formulation increased the effective pH for sorbic acid inhibition of toxin production. The rapid rate of germination and outgrowth in both control and nitrite-containing treatments was not influenced by pH in the range examined (5.93-6.93). When sorbic acid was included in the formulation, there was a slower nitrite depletion during storage. This effect was also pH dependent and it was not observed at higher pH values (7.15). Total microbial growth was affected by decreasing pH, but not by the inclusion of nitrite and/or sorbic acid in the formulation. IFT

59

Nitrites and nitrates - FACC review of their uses in cured meats and cheese.

Anon.

British Food Journal 81 (890) 79-81 (1979) [7 ref. En]

The UK Food Additives & Contaminants Committee's review of the use of nitrites and nitrates in food is discussed, and the action of these substances as components of pickling mixtures for meat products and in cheese is briefly described. The distribution of natural nitrates, the carcinogenic potential of nitrites when converted to nitrosamines, and the antimicrobial activity of nitrate and nitrite are also discussed. JRR

60

[Curative mineral drinking waters, medicinal and natural table waters. Determination of nitrite ions.] Union of Soviet Socialist Republics, Gosudarstvennyi Komitet SSSR po Standartam

Soviet Standard GOST 23268.8-78, 4pp. (1978) [Ru]

This standard stipulates conditions for detn. of nitrite ions in the title waters by (i) rapid visual colorimetric and (ii) photometric methods (using Griess reagent). For (i), the colour intensity of the sample shall not exceed that of a reference solution in 2 parallel tests. (ii) permits detn. of 0.005–0.03 mg nitrite ions/sample; max. permissible deviation between 2 parallel detn. is 2%. KME

61

[Curative mineral drinking waters, medicinal and natural table waters. Determination of nitrate ions.] Union of Soviet Socialist Republics, Gosudarstvennyi Komitet SSSR po Standartam

Soviet Standard GOST 23268.9-78, 6pp. (1978) [Ru]

This standard stipulates conditions for detn. of nitrate ions in the title waters by 2 colorimetric methods, (i) a rapid method using diphenylamine, and (ii) a reference method using phenol-disulphonic acid. Limits of detection are 0.001–0.005 and 0.005–5.0 mg/sample for (i) and (ii), resp. Max. permissible deviation between 2 parallel detn. is given for (ii), viz. 0.5 mg/l. KME

62

[Studies on relation of nitrate and nitrite contents in Korean foods and human saliva.]

Ko, Y. S.

Korean Journal of Food Science and Technology 11 (3) 147–152 (1979) [59 ref. Ko, en] [Inst. of Food Sci., Hanyang Univ., Seoul, Korea]

The contents of nitrate and nitrite in Korean foods and human saliva were determined using the Cd reduction method and the diazotization-coupling reaction resp. Saliva samples were taken from 150 female students, 19–22 yr old, and 10–20 samples of foods were analysed. Nitrate contents (p.p.m.) in foods were Chinese cabbage 2500, spinach 2000, radish 2000, cabbage 500, ham and sausage 300, cucumber 300, carrot 300, beans 200, egg plant 150, tomato 80, potato 80, and onion 70. At nitrate intake levels of <50, 50–100 and >100 mg, nitrite and nitrate saliva contents (p.p.m.) were resp., 13.7 and 62.4, 22.0 and 101.7 and 25.3 and 125.5. [From En summ.] SP

63

[Nitrates, nitrites and nitrosamines.] Nitrate, Nitrite und Nitrosamine.

Liepe, H.-V.; Pfeil, E.

Fleischwirtschaft 59 (6) 826–830; 851 (1979) [De, en] [Fa. Rudolf Müller & Co., Giessener Strasse 94, 6301 Pohlheim 1, Federal Republic of Germany]

This review-type article discusses the role of nitrates, nitrites and nitrosamines in biological processes, and shows that their part in the natural N cycle makes it impossible to prevent their introduction into the diet. RM

64

[Manufacture of Gouda cheese with low nitrate.] Mottar, J.; Waes, G.

Revue de l'Agriculture 31 (3) 525–540 (1978) [32 ref. Fr, en] [Sta. Laitiere de l'Etat, Chaussee de Bruxelles, 370, B-9230 Melle, Belgium]

To prevent butyric acid fermentation during the manufacture of Gouda cheeses, 15 g NaNO_3 are added/100 l milk. Because of the carcinogenic nature of nitrosamines that may be formed by the reaction of nitrites with secondary amines, cheeses were manufactured with reduced levels of added NaNO_3 , either with (i) 10 g NaNO_3 added directly to 100 l cheese milk or with (ii) 9 or 7 g NaNO_3 added later to 50 l whey + curds after draining off the first 50 l whey. Mean contents of NO_3^- in control cheeses were 41.0 mg/kg after turning and 18.9 mg/kg after maturation for 14 wk. Corresponding values for (i) and (ii) cheeses were 27.9 and 31.7 mg/kg after turning and 9.2 and 12.6 mg/kg after maturation for 14 wk. Nitrite contents were <1.0 mg/kg in all cheeses. Both methods (i) and (ii) were effective in preventing development of butyric acid bacteria in Gouda cheese. MEG

65

[Browning of cheese affected by nitrates.]

Görner, F.

Prumysl Potravin 30 (8) 454–456 (1979) [Sk]

[Slovenska Vysoka Skola Tech., Chemickotech. Fak., Bratislava, Czechoslovakia]

A defect which occurred in 'Dutch brick' cheese at a dairy plant in Slovakia was characterized by brown discoloration in the peripheral region which also contained more eyes than the rest of the cheese. Detailed analysis of the defective specimens revealed greatly increased NO_2^- and NO_3^- contents in the brown coloured cheese portions. Further studies showed that halophilic microorganisms participated in the formation of brown colour and that NO_2^- was produced by bio-reduction of NO_3^- . Browning of cheese could be reproduced under laboratory conditions. FL

66

[Effect of different curing aids on nitrite/nitrate breakdown in raw cured meats.] Nitrit-/Nitrat-Abbau in Rohpökelwaren in Abhängigkeit von verschiedenen Pökelhilfsstoffen.

Mathey, R.

Fleischwirtschaft 59 (11) 1639–1640, 1642–1646, 1648–1650; 1699 (1979) [14 ref. De, en] [Im Alheck 6, 6640 Merzig, 1 Federal Republic of Germany]

The effects of the curing aids ascorbic acid (AA), sodium ascorbate (NaA) and glucono- δ -lactone (GdL) on nitrite curing salts and formation of red meat colour (nitrosomyoglobin) are reviewed. Using a 20% brine (1000–1200 p.p.m. NaNO_2^-), it was found that about 40% of NO_2^- is lost as volatile NO gas immediately upon addition of AA. GdL caused a loss of 0.07 and 1.0% NO_2^- (2 batches) and also reduced NO_3^- to NO_2^- ; this effect was lessened by NaA. 9 batches of cured meat were produced with 20% brine and additions of 0.2% KNO_3 , 0.4% AA, 0.5% NaA and 1.0% GdL, alone and in various combinations. Results, shown

graphically and in tables, revealed that if only NO_2^- -curing salt is used, much of the NO_2^- is converted to NO_3^- ; AA and NaA completely break down NO_2^- , but have no effect on NO_3^- (leaving only NO_3^- residues); addition of $\text{KNO}_3 + \text{GdL} + \text{NaA}$ resulted in the highest NO_3^- residues (121.8 p.p.m. in meat after 21 days, while no NO_2^- remained), possibly due to defective NO_3^- -reducing microorganisms as a result of pH drop to 5.2–5.4; max. reddening was observed after 6 and 12 days with added KNO_3 and AA resp., but continuous increase in colour up to 21 days with all other additives. The most effective additives for good colour and low NO_2^- and NO_3^- residues concn. was AA (no NO_2^- , 19.1 p.p.m. NO_3^- on day 21, or 60.5 p.p.m. NO_3^- with combined KNO_3 addition); if loss of NO_2^- is to be avoided, combination of GdL with NaA gave good colour, no residual NO_2^- and 58.6 p.p.m. NO_3^- on day 21. RM

67

[German standard methods for examination of water, waste water and sludge. Anions (Group D). Determination of nitrate (D 9).] Deutsche Einheitsverfahren zur Wasser-, Abwasser- und Schlammuntersuchung. Anionen (Gruppe D). Bestimmung des Nitrat-Ions (D9). Germany, Federal Republic of, Deutscher Normenausschuss
German Federal Republic Standard DIN 38 405, Teil 9, 8pp. (1979) [3 ref. De]

This standard specifies 3 analytical techniques for detection or detn. of NO_3^- in water (including drinking water): a qualitative technique based on mixing the sample with conc. H_2SO_4 (sp. gr. 1.84) followed by addition of solid brucine, formation of a red coloration indicating the presence of NO_3^- ; a photometric quantitative method based on reaction of NO_3^- (in $\text{H}_2\text{SO}_4/\text{H}_3\text{PO}_4$) with 2,6-dimethylphenol and detn. of the extinction value of the resulting reaction product at 324 nm; and a quantitative method based on reaction of NO_3^- with *p*-fluorophenol in a H_2SO_4 -containing medium to give 2-nitro-4-fluorophenol, which is separated by distillation, collected in NaOH, and determined by spectrophotometry at 430 nm. AJDW

68

[Method for separation of nitrites from nitrates applicable to their determination in foods. I.] Cuzzoni, M. T.; Gazzani, G.

Industria Alimentari 18 (10) 703–706 (1979) [17 ref. It, en] [Lab. di Chimica degli Alimenti, Univ. degli Studi di Pavia, Pavia, Italy]

Nitrites are separated from nitrates by distillation of nitrous vapours and collection of the distillate in an alkaline solution. In the absence of O_2 , nitrite recovery is rapid, reproducible and > 87%; s.d. is 1.4 and coeff. of variability 1.59. The method is applicable to detn. of nitrates and nitrites in foods. AS

69

[Nitrates, nitrites, nitrosamines and bacteria.] [Review]

Cantoni, C.; D'Aubert, S.; Perlasca, M.
Industria Alimentari 18 (10) 741–745 (1979) [58 ref. It, en] [Istituto di Ispezione degli Alimenti di Origine Anim., Univ. degli Studi di Milano, Milan, Italy]
Bacterial synthesis of nitrates, nitrites and nitrosamines is reviewed, with particular reference to nitrite production by Enterobacteriaceae. AS

70

Formation of DNA-damaging and mutagenic activity in the reaction systems containing nitrite and butylated hydroxyanisole, tryptophan, or cysteine. Nataka, M.; Danno, G.-I.; Maeda, T.; Kawamura, K.; Kanazawa, K.

Journal of Nutritional Science and Vitaminology 25 (4) 317–332 (1979) [22 ref. En] [Dep. of Agric. Chem., Kobe Univ., Nada-ku, Kobe 657, Japan]

The rec-assay test was used to detect DNA-damaging activities formed by the reactions between food additives and food ingredients, and it was confirmed that DNA-damaging activities were formed in the reaction systems containing nitrite and phenol derivatives including BHA, tryptophan or cysteine under gastric pH conditions. The mutagenic action of the nitrite-BHA (NB), nitrite-tryptophan (NT) and nitrite-cysteine (NC) systems was also tested by the Ames method using *Salmonella typhimurium* TA 1535 and TA 98, and activity was shown in the NT and NC systems. The DNA-damaging activity decreased significantly after 1.5–2 h of reaction in NT and NC systems, but did not decrease even after 48 h in the NB system; nitrosophenol derivatives themselves showed such activity at pH 1. The active product in the NB system was determined to be 2-*tert*-butyl-quinone (positive rec-assay test, no mutagenesis) and in the NC system was inferred to be nitrosocysteine, which showed both DNA-damaging and mutagenic activity. AL

71

[Nitrite and nitrate contents of wheat products used for tortellini and ravioli.]

Cantoni, C.

Tecnica Molitoria 30 (9) 667–668 (1979) [8 ref. It] [Istituto di Ispezione degli Alimenti di Origine Anim., Univ. degli Studi di Milano, Milan, Italy]

10 samples each of bread crumbs prepared from (i) white bread or (ii) wholemeal bread were analysed for nitrates and nitrites. Both (i) and (ii) had nitrite concn. ranging from traces to 26.6 mg/kg. Nitrate concn. of (i) ranged from 39.0 to 97.6 mg/kg; that of (ii) ranged from 30 to 112.2 mg/kg. These results are discussed in relation to nitrate and nitrite concn. in fillings for ravioli etc. made using bread crumbs; legal aspects and labelling requirements are discussed. AJDW

72

Temperature requirements of meat products with a reduced level of added nitrite

Lücke, F.-K.; Leistner, L.

Fleischerei 30 (9) 692–694, iii–iv (1979) [16 ref. En, De, Fr, Es] [Inst. für Bakteriologie & Histologie, Bundesanstalt für Fleischforschung, D-8650 Kulmbach, Federal Republic of Germany]

The desirability of minimization of added nitrite concn. in cured meat products is briefly considered, with reference to the danger of nitrosamine formation. Reduction of nitrite content may, however, increase susceptibility of the product to growth and toxin formation by *Clostridium botulinum*. Temp. requirements for control of *Cl. botulinum* in meat products are discussed, with reference to: temp. resistance, NO_2^- resistance, and low temp. and a_w tolerance of *Cl. botulinum* strains; interrelation of factors controlling growth of *Cl. botulinum*; necessary conditions for prevention of growth of *Cl. botulinum* in raw ripened sausage, other sausage types, raw ham, and meat products fully or partially preserved by heat treatment (covering NO_2^- level, heat treatment and storage temp.); and control of other food poisoning organisms (staphylococci, salmonellae). AJDW

73

The current situation with respect to nitrate/nitrite problems.

Leistner, L.

Fleischerei 30 (8) 603-608 (1979) [27 ref. En, De, Fr, Es] [Bundesanstalt für Fleischforschung, Oskar-von-Miller-Strasse 20, D-8650 Kulmbach, Federal Republic of Germany]

Aspects discussed include: the role of nitrite in control of *Clostridium botulinum* and development of quality characteristics in meat and meat products; formation of nitrosamines from nitrites and amines; formation of nitrite from nitrate; possible carcinogenicity of nitrites; current problems with the legal status of use of nitrite in meat products in the USA; the potential for reducing nitrate and nitrite levels in cured meat products; possible ways of compensating for the lower microbiological stability of low-nitrite products (addition of sorbates, pH adjustment, heat-treatment, cold storage, etc.); and problems likely to result from a total ban on nitrate and nitrite in meat products. AJDW

74

Effect of sodium nitrite on the bioavailability of meat iron for the anemic rat.

Mahoney, A. W.; Hendricks, D. G.; Gillett, T. A.; Buck, D. R.; Miller, C. G.

Journal of Nutrition 109 (12) 2182-2189 (1979) [31 ref. En] [Dep. of Nutr. & Food Sci., 87, Coll. of Family Life & Agric., Utah State Univ., Logan, Utah 84322, USA]

During the curing of meat, added nitrite is converted to nitric oxide which covalently combines with the porphyrin bound Fe yielding the characteristic pink colour of cured meat upon heating. Anaemic rats were fed diets containing bologna prepared with different levels of nitrite to determine the effects of nitrite curing on the bioavailability of meat Fe. In experiment 1, the efficiency of converting meat Fe to haemoglobin Fe was decreased from 58 to 39% and water extractable Fe decreased from 8.7 to 2.6 mg/kg bologna as sodium nitrite added to the bologna emulsion was increased from 0 to 50 p.p.m. The efficiency of converting meat Fe to haemoglobin Fe tended to increase at sodium nitrite levels above 50 p.p.m. In experiment 2, the apparent

absorption values were not decreased in response to adding sodium nitrite to the bologna emulsion but the efficiency of the conversion of absorbed meat Fe to haemoglobin Fe was clearly depressed. In experiment 3, addition of 12 mg nitrite/kg casein or bologna diet, an amount equivalent to the residual nitrite present in the high nitrite bologna, caused increases in the haematinic response. This is discussed in terms of nitrosylmethaemoglobinemia and relative tissue hypoxia. The results of experiment 1 were confirmed in experiment 4. Thus, using a very sensitive animal model it has been possible to show that even very low levels of nitrite used in curing meat can have measurable physiological effects on the metabolism of meat Fe. Furthermore, very low levels of dietary nitrite from any source may be physiologically significant. AS

75

Chemical analysis of cheese. Part 9. Determination of nitrate and nitrite contents. Method by cadmium reduction and photometry.

United Kingdom, British Standards Institution
British Standard BS 770:Part 9, 7pp. ISBN 0-580-11121-0 (1980) [En] [2 Park Street, London W1A 2BS, UK]

This standard is identical with ISO 4099-1978 and IDF Standard 84:1978 [see FSTA (1979) 11 8U609 and 3U143 resp.] [See FSTA (1976) 8 7U386 for part 7]

76

[Meat and meat products. Determination of nitrites.]

Central America, Instituto Centroamericano de Investigación y Tecnología Industrial

Central American Standard ICAITI 34 125 Part 9, 5pp. (1977) [Es] [Avenida La Reforma 4-47, Guatemala City, Guatemala]

This standard specifies a method for detn. of nitrites in meat and meat products, based on extraction of nitrite from the sample with boiling water, precipitation of protein in the extract by addition of $\text{K}_4\text{Fe}(\text{CN})_6$ and zinc acetate/acetic acid reagents, separation of the precipitate by filtration, and detn. of nitrite in the filtrate by spectrophotometry at 538 nm after reaction of the nitrite with sulphanilamide/*N*-1-naphthylethylenediamine reagent. Replicate analyses should give results differing by $\leq 10\%$ of the mean value. AJDW

77

[Meat and meat products. Determination of nitrate content.]

Central America, Instituto Centroamericano de Investigación y Tecnología Industrial

Central American Standard ICAITI 34 125 Part 10, 7pp. (1977) [Es] [Avenida La Reforma 4-47, Guatemala City, Guatemala]

Nitrates + nitrites are extracted from the sample, using boiling water; proteins are precipitated using $\text{K}_4\text{Fe}(\text{CN})_6$ and zinc acetate, and the precipitate is separated by filtration. Nitrate in the filtrate is then reduced to nitrite by means of a Cd column. Total nitrite (i.e. that originally present + that formed from nitrate)

is then determined by the sulphanilamide/*N*-1-naphthylethylenediamine method specified in ICAITI 34 125 part 9 [see preceding abstr.]. An equation for calculation of nitrate concn. in the sample is given. Replicate analyses should differ by $\leq 10\%$ of their mean value. AJDW

78

Nitrites in bacon; proposed exception from the color additive definition and request for information on other meat products that may qualify for the exception to the color additive definition.

United States of America, Food & Drug Administration

Federal Register 44 (247, Dec. 21) 75659-75662 (1979) [En] [Washington, DC, USA]

The Food and Drug Administration tentatively concludes that when nitrites (including nitrates) are added to bacon at levels of about 120 p.p.m. for preservation by inhibiting outgrowth of *Clostridium botulinum* spores, the colouring effect produced by only 10-30 p.p.m. is unavoidable. CAS

79

Mutagenicity of products obtained from cysteamine-glucose browning model systems.

Mihara, S.; Shibamoto, T.

Journal of Agricultural and Food Chemistry 28 (1) 62-66 (1980) [19 ref. En] [Ogawa & Co. Ltd., 6-32-9 Akabanenishi, Kita-ku, Tokyo, Japan]

The reaction mixture obtained from a cysteamine/*D*-glucose/water browning model system was separated into 11 fractions, 7 from the methylene chloride extract by HPLC and 4 from the residual aqueous solution by ion-exchange column chromatography. Each fraction was tested for mutagenicity by the Ames' *Salmonella* test using TA 98 and TA 100, with or without S-9 mix. The reaction mixtures obtained from cysteamine/*D*-glucose/ NaNO_2 model systems were also examined for mutagenicity, with positive results. 8 thiazolidines and 5 *N*-nitrosothiazolidines, some of which were found in the above model systems, were synthesized and tested for mutagenicity. All thiazolidines tested showed some mutagenicity at certain concn. AS

80

Radiation-sterilization of food: treating scanty data from inoculated packs.

Ross, E. W., Jr.

Journal of Food Protection 42 (12) 924-926 (1979) [8 ref. En] [US Army Natick Res. & Development Command, Natick, Massachusetts 01760, USA]

This paper is about the mathematical methods used in calculating the 12D [i.e. safe] radiation-dose for a food which has been subjected to an inoculated pack. It concerns the case in which only one partial-spoilage data point is obtained from the experiment. A simple, partly graphical procedure is described. This method is based on binomial confidence limits and furnishes an estimate that lies above the (unknown) true 12D value with probability $> 90\%$. The method is applied to an inoculated pack for low-level nitrite/nitrate ham described by Anellis et al. [See also FSTA (1980) 12

7S1135.] [In *Spore Research* (1977), A. N. Barker, G. W. Gould & J. Wolf (editors), Academic Press, New York, USA] AS

81

Formation of *N*-nitrosamines from Maillard browning reaction products in the presence of nitrite.

Coughlin, J. R.
Dissertation Abstracts International, B 40 (2) 719: Order no. 79-17151, 344pp. (1979) [En] [Univ. of California, Davis, California 95616, USA]

Chemical studies and Ames *Salmonella*/microsome mutagenicity assays were conducted on potentially carcinogenic/mutagenic volatile and non-volatile *N*-nitroso compounds formed from Maillard reaction products in the presence of nitrite, particular attention being paid to the *N*-nitrosation of secondary amine Amadori compounds (*N*-substituted-1-amino-1-deoxy-2-ketoses). Ames assays indicated that *N*-nitrosated Amadori compounds can act as direct mutagens on *S. typhimurium*. Amadori compounds occur widely in browned heat-processed foods and beverages and it is suggested that these compounds may contribute to the causation of human gastro-intestinal tract cancer, either by ingestion of preformed compounds or by in vivo nitrosation of precursor Amadori compounds following ingestion. HPLC separation of Amadori compounds was achieved by using reversed-phase, ion-pairing chromatography and a bonded NH_2 column. Other chromatographic techniques were also used to study the Amadori compounds. Further studies included successful *N*-nitrosation in acidic NaNO_2 solution of the 1:1 *D*-glucose/*L*-cysteine condensation product containing the thiazolidine ring; the resulting β -oxidized *N*-nitrosamine is a potential carcinogen/mutagen which could readily form in nitrite-containing foods or by in vivo nitrosation of the condensation adduct in the gastro-intestinal tract. JA

82

Nitrate levels in groundwater from the Fleuve, Senegal. [Lecture]

Berwick, M.

Progress in Water Technology 11 (1) 117-120; (2) 403-406 (1979) [20 ref. En] [School of Epidemiology & Public Health, Yale Univ., 60 College Street, New Haven, Connecticut 06520, USA]

Water samples were collected from a number of sources within a 100 km radius of St. Louis, Senegal. Nitrate content of water was determined using the Brucine colorimetric method (a standard method used by the American Public Health Association). Salinity (mg Cl/l) was also determined, and in some instances, total Fe concn. Nitrate contents (mg/l) of 9 water samples were: 0.3, 0.3 and 0.4 in tap water; 35.4, 226 and 15 in well water; and 1.02, 1.0 and 0.6 in river water. The well water sample from Savoigne had nitrate level (226 mg/l) greatly in excess of the 45 mg/l max. which WHO suggests as unsafe in drinking water. Salinity (mg Cl/l) was, resp.; 12, 28 and 148 in tap water, 40, 2660 and 16 in well water, and 420, 20 and 8 in river water. Fe content was 0.02, 0.03 and 0.95 mg/l in the 3 well water samples. No correlation was seen between salinity and level of nitrates, nor Fe content. Infants drinking dried

milk diluted with high nitrate-containing water are at high risk of developing methaemoglobinaemia. Further health risks to the population may occur because the water from the wells is stored in large metal containers. In the discussion on this paper, L. G. Hutton (pp. 405-406, 4 ref.) reports a new development in the field-testing of water supplies which enables spot determinations of nitrate, nitrite and NH_3 to be made. A test strip (developed by Merck of Darmstadt, West Germany) is dipped in the water and if nitrate is present a red-violet colour is produced on the sensitized part of the strip; after 2 min the colour is compared to a colour scale printed on the side of the container and the amount of nitrate present is read off. Other methods presently available for analysis of nitrates are briefly mentioned. [See FSTA (1980) 12 7H1036.] AL

83

Effect of nitrapyrin on nitrate content and nitrapyrin residues in red beets fertilized with urea. [Lecture] Puntari, I.; Kallio, H.; Kontiainen, E.; Linko, R. R. *Kemia-Kemi* 6 (12) 761 (1979) [En] [Dep. of Chem. & Biochem., Univ. of Turku, SF-20500 Turku 50, Finland]

Effect of the nitrification inhibitor (i) nitrapyrin [2-chloro-6-(trichloromethyl)pyridine] on residues of (i) and (ii) the hydrolysis product 6-chloropicolinic acid, and on contents of nitrate in beet (*Beta vulgaris* L. var. *conditiva*) were studied. Raw roots had 1/100 the level of (i) found in soil; (ii) levels in raw roots were higher than in soil. No (i) or (ii) was found in processed canned beets. Beet nitrate content decreased with increasing application of (i) up to 18 kg/ha. [See FSTA (1980) 12 7A446]. DIH

84

Determination of nitrate and nitrite in whey powder. Sen, N. P.; Lee, Y. C.

Journal of Agricultural and Food Chemistry 27 (6) 1277-1279 (1979) [3 ref. En] [Food Res. Div., Health Protection Branch, Ottawa, Canada K1A 0L2]

2 methods are described for detn. of nitrate and nitrite in dried whey. Both methods are based on diazotization and coupling reactions, and final quantitation by colorimetric measurement. One method worked well with the majority of the samples, with the exception of a few which produced turbid or coloured extracts. The other method, which uses an extra ion-exchange cleanup step, was useful in analysing these troublesome samples. The methods were applied to analysis of 15 whey powder samples, some of which (those prepared from cheese milk containing nitrate as an additive) contained high (up to 1760 p.p.m.) levels of nitrate. Average % recovery of nitrate added to various whey powders at levels of 30-50 p.p.m. was 96.4 and that for nitrite at levels of 10-30 p.p.m. was 89.6. Min. detection limit is about 2-10 p.p.m. depending on sample size taken for analysis. The 2nd method has the potential for analysis of nitrate and nitrite in other difficult-to-analyse samples, such as animal feed. AS

85

[Is saltpetre dispensible in cheesemaking?] [Review] Nielsen, E. W.

Maelkeritidende 93 (4) 97-102 (1980) [17 ref. Da] [Dan

Kongelige Veterinaer- og Landbohøjskole, Copenhagen, Denmark]

Nitrate, often in the form of KNO_3 , is added to cheese milk to prevent fermentation of butyric acid bacteria, which are inhibited by the nitrite formed from the nitrate. This review considers possible ways of reducing or eliminating the use of nitrate for this purpose, including: decreasing the number of butyric acid bacteria spores in the cheese milk, e.g. by bacto-fugation; use of bacteria which produce nisin or other substances inhibiting butyric acid bacteria; addition of lysozyme to cheese milk; and early salting of the cheese. Danish experiments with lysozyme and with early salting (involving addition of ≤ 2250 g salt/100 l cheese milk at an early stage in Samso cheese manufacture, while the curd was still being stirred) are reported in detail. It is claimed that useful results have been obtained from these experiments, which, together with other research, should provide a basis for the development of satisfactory alternatives to the use of nitrate in cheesemaking. ADL

86

[Automated determination of nitrate and nitrite in milk and dairy products by means of continuous flow analysis.] Die automatisierte Bestimmung von Nitrat und Nitrit in Milch und Milcherzeugnissen in der kontinuierlichen Durchflussanalyse.

Nijhuis, H.; Heeschen, W.; Blüthgen, A.

Milchwissenschaft 34 (7) 414-416 (1979) [7 ref. De. en] [Inst. für Hygiene, Bundesanstalt für Milchwissenschaft, Kiel, Federal Republic of Germany]

The method consists of reducing nitrate to nitrite by means of hydrazine sulphate, and reacting the nitrite with sulphanilamide and *N*-(1-naphthyl)ethylenediamine dihydrochloride. The resulting colour is measured at 520 nm and the total nitrite + nitrate content calculated. Milk samples are analysed without addition of hydrazine sulphate to give the amount of nitrite originally present, and nitrate content is calculated by difference. The precision of the method is discussed. Milk samples can be stored satisfactorily at 5°C for 3 days or at -20°C for 14 days before analysis. MEG

87

Distribution, production, analysis and effects of aflatoxin in animal tissues and effects of scirpene toxins on chicken embryos.

Obioha, I. W.

Dissertation Abstracts International, B 40 (5) 2103-2104: Order no. 79-24259, 152pp. (1979) [En] [Iowa State Univ., Ames, Iowa 50010, USA]

Studies of the effects on 3-wk-old chickens of a single oral dose of 1 mg ^{14}C -labelled aflatoxin B_1 and on 6-wk-old chickens of a single oral dose of 10 mg unlabelled aflatoxins indicated that most of the aflatoxins were excreted in the faeces within 48 h and that of the aflatoxins retained most occurred in the liver. A further study involved inoculation of fresh pork sausage (containing 2.5% NaCl and either 156 or 200 p.p.m. NaNO_2) with *Aspergillus parasiticus* and incubation at 5, 26 or 37°C. No mould growth and no aflatoxin production were observed at 5°C. Mould growth and

afatoxin B₁ production were observed at 26° or 37°C, more aflatoxin being produced at the lower temp. A final study involved spreading *Asp. parasiticus* on Sabouraud glucose agar (containing 50, 156, 200 or 500 p.p.m. nitrite as NaNO₂) and incubating at 24°C. Examination after 4 days indicated more mould growth at the lower nitrite levels; storage for >4 days resulted in more mycelia and spore formation at the higher nitrite levels. JA

88

[Effect of nisin and nitrite, separately and together, on spore germination of *Clostridium perfringens* in cooked meat emulsions.]

Caserio, G.; Stecchini, M.; Pastore, M.; Gennari, M. *Industria Alimentari* 18 (12) 894-897, 900 (1979) [25 ref. It] [Istituto di Ispezione degli Alimenti di Origine Anim., Univ. di Milano, Milan, Italy]

In continuation of earlier work on the effect of nisin on the keeping quality of hams, Mortadella and Wurstel sausages [see FSTA (1979) 11 11S1780], 3 series of tests were carried out to determine effects of nisin and/or nitrite on *Cl. perfringens* spores in Wurstel sausage meat. The 1st, preliminary, series aimed at evaluating the heat stability of the spores (200/g) in the presence of 20 g/100 kg nisin + 0, 75 or 150 p.p.m. NaNO₂ after heating at 72°C for 1 h and subsequent storage for 1 and 8 days at 6-8°C. Nisin + nitrite (either concn.) effectively inhibited spore germination. In the 2nd series, Wurstel sausages were inoculated with 70 spores/g and treated as in the 1st series (but with 100 instead of 150 p.p.m. nitrite) and stored for 1-38 days at 2-4°C, 33 days at 4-6°C or 20 days at 20°C. Best results were obtained with nisin + 75 p.p.m. nitrite, which killed off the spores or prevented germination, but did not affect the sensory characteristics of the product. In the 3rd series of tests, the residual concn. of nisin was determined in Wurstel sausages after 28 days at 2-4°C; the concn. found was 43% of the initial level of 20 p.p.m. HBr

89

Effect of sodium chloride on residual nitrite.

Lee, M.; Cassens, R. G.

Journal of Food Science 45 (2) 267-269, 273 (1980) [En] [Coll. of Agric. & Life Sci., Univ. of Wisconsin, Madison, Wisconsin 53706, USA]

Effect of NaCl on residual nitrite was studied in a model system, ground meat and bacon. The model system contained 10% bovine serum albumin, 156 p.p.m. NaNO₂ and 0, 1.5, 2.5, or 3.5% NaCl. The ground pork system consisted of 156 p.p.m. NaNO₂ and 0, 1.5, 2.5, or 3.5% NaCl. Bacon was made under pilot plant conditions to contain 156 p.p.m. NaNO₂ and 0, 1.5, or 3.0% NaCl. The results showed that residual nitrite was lower in the presence of larger amounts of NaCl; however, if the effect of NaCl in decreasing pH and the effect of loss of water during cooking and storage were excluded, then NaCl did not cause significant decreases in residual nitrite. IFT

90

[Determination of nitrite and nitrate in commercial meat products.]

Schocken, R. P. I.; Faleiros, R. R. S.; Sampaio, A. A. M.; Oliveira, M. D. S.

Cientifica 7 (Especial) 111-114 (1979) [16 ref. Pt, en] [Dep. de Microbiol., Fac. de Ciencias Agrarias & Vet., 'Campus de Jaboticabal', Sao Paulo, Brazil]

A total of 63 samples of 3 brands of 3 different meat products (sausages, ham, bacon) were analysed. Concn. found ranged from 40 to 70 p.p.m., which is within the Brazilian legal limits. However, these concn. would not guarantee inhibition of *Clostridium botulinum* growth. AS

91

Nitrite update: search intensifies for bacon curing alternatives.

Ranieri, S.

Food Product Development 13 (10) 28, 30 (1979) [En]

A status report is given on the most promising alternatives to date to the present nitrite/ascorbate system for curing bacon. Alternatives considered are: *Lactobacillus* culture; α-tocopherols; irradiation; and nitrite/sorbate cure. At present the *Lactobacillus* culture method is the only proposed method to receive USDA approval as a safe alternative to the current system of 120 p.p.m. ingoing sodium nitrite with 550 p.p.m. ascorbate. VJG

92

Method for the measurement of hydroxylamine in colonic fluid using derivatisation and gas chromatography.

Darke, D. J.; Roediger, W. E. W.

Journal of Chromatography 181 (3/4) 449-452 (1980) [10 ref. En] [Analytical R & D Unit, Building 148, AERE, Harwell, Oxon., UK]

In view of the controversy over the potential harmfulness of nitrites (as food preservatives) in the form of hydroxylamine (HA) (formed during colonic bacterial reduction of nitrate), a method for detection of HA in biological samples (stool water) has been developed. The method is believed to be specific for HA. HBr

93

[Meat products. Method for determination of nitrates.]

Union of Soviet Socialist Republics, Gosudarstvennyi Komitet SSSR po Standartam

Soviet Standard GOST 8558.2-78, 8pp. (1979) [Ru]

This standard, which partially supersedes GOST 8558-68, applies to all types of meat product made with use of nitrates, brines or salt solutions. The method is based on reduction of nitrate to nitrite, with photometric measurement of the intensity of the colour formed on interaction of sulphonylamide and N-(1-naphthyl) ethylenediamine dihydrochloride with the nitrite, and subsequent mathematical conversion to nitrate. The standard corresponds to ISO 3091-75. The difference between 2 parallel detn. shall not exceed 0.2 mg/100 g product. KME

94

[Meat products. Method for determination of nitrites.]

Union of Soviet Socialist Republics, Gosudarstvennyi Komitet SSSR po Standartam

Soviet Standard GOST 8558.1-78, 6pp. (1979) [Ru]

This standard, which partially supersedes GOST 8558-68, applies to all types of meat products made with use of nitrites, brines or salt solutions. The analytical method is based on photometric measurement of the intensity of the colour formed on interaction of nitrite with sulphanilamide and *N*-(1-naphthyl) ethylenediamine dihydrochloride in a protein-free filtrate. The standard corresponds to ISO 2918-75. The difference between 2 parallel detn. shall not exceed 0.2 mg/100 g product. KME

95

The agricultural industry and its effects on water quality. [Conference proceedings]

Jenkins, S. H. (International Association on Water Pollution Research) (Editor)

Progress in Water Technology 11 (6) 1-727 (1979) [many ref. En]

This issue of the journal contains the proceedings of a conference on the agricultural industry and its effects on water quality, held at the University of Waikato, Hamilton, New Zealand on 15-18 May 1979. Papers include: Nitrate and chlorides in groundwater, surface water and deep soil profiles of Central Canterbury, New Zealand, by J. A. Adams, A. S. Campbell, W. R. McKeegan, R. J. McPherson & P. J. Tonkin (pp. 351-360, 7 ref.). The effects of land use and hydrology on groundwater quality in mid-Canterbury, New Zealand, by B. F. Quin & R. J. Burden (pp. 433-448, 20 ref.). A further 4 papers are abstracted separately in FSTA and can be found in the author index under International Association on Water Pollution Research [Agriculture & Water Quality Symposium]. AL

96

[Determining nitrate concentration from UV spectra of well water samples.] Die Ermittlung des Nitratgehalts aus UV-Spektren von Brunnenwasser-Proben.

Randow, F. F. E.; Torun, D.

Zeitschrift für die Gesamte Hygiene und ihre Grenzgebiete 25 (12) 913-916 (1979) [24 ref. De, en, ru] [Lehrstuhl Allgemeine & Kommunale Hygiene, Bereich Med., Wilhelm-Pieck-Univ., Rostock, German Democratic Republic]

UV spectra of well water etc. can provide information on NO_3^- concn., in addition to general conclusions concerning the level of pollution. For NO_3^- detn., the water sample is purified by membrane filtration, after which the UV spectrum is determined against a blank, over the range 200-350 nm. Interference by organic substances is determined by an extrapolation method, and deducted from the extinction value at 205 nm; NO_3^- concn. may then be calculated by multiplying the corrected extinction value by a factor of 6.3. Error is 4-14% over the NO_3^- concn. range 4-

700 mg/l. The method is recommended for monitoring of surface and ground water. IN

97

[Bacteriological aspects of keeping warm freshly prepared spinach. Relation between bacterial counts and nitrate reduction.] Bakteriologische Aspekte des Warmhaltens von frisch zubereitetem Spinat. Zusammenhang zwischen der Keimzahl und der Nitratreduktion.

Bomar, M. T.; Wedler, A.-M.

Nutrition and Metabolism 24 (2) 65-75 (1980) [11 ref. De, en] [Bundesforschungsanstalt für Ernährung, Karlsruhe, Federal Republic of Germany]

Possible microbial reduction of nitrate to nitrite in cooked spinach that is held warm for some time before consumption was investigated under controlled conditions. Cooked spinach was (i) sterilized, to act as control, and after sterilization samples were inoculated with (ii) *Bacillus stearothermophilus* (thermophile), (iii) *Bacillus cereus* (mesophile), or (iv) *Enterobacter liquefaciens* (cold-tolerant). Samples were then incubated and NO_3^- and NO_2^- contents were determined. Incubation conditions were for (ii) 60°C 3 and 5 h, (iii) 25°C 5 and 8 h and (iv) 10°C 18 and 24 h. (i) samples received all incubation treatments. No (i) samples produced NO_2^- under any condition, showing that the heat treatment itself was not responsible for NO_2^- production. NO_2^- contents for initial inoculation with (ii) at approx. 10^5 cells/g were, after the short and long incubation times 19.9 and 90.8 mg/kg, resp. Corresponding results for (iii) at 10^6 cells/g initially, were 71.0 and 174 mg/kg, and for (iv) at 10^2 cells/g, 0.47 and 0.45 mg/kg. Further investigations showed that production of nitrite by microorganisms was dependent on initial inoculum level, levels of approx. 10^2 /g for (ii) and (iii) not producing nitrite after the usual incubation times, and 10^3 cells/g of (iv) producing 5.5 and 23.4 mg NO_2^- /kg after 18 and 24 h resp. at 10°C. Nitrite content of spinach could only be a potential problem for human health if there was extensive microbial contamination and incubation under conditions suitable for the contaminant. The simple nitrite test is recommended as a measure of spinach bacteriological quality. DIH

98

Sodium nitrite and sorbic acid control of *Clostridium botulinum* toxinogenesis in emulsions formulated with various meats and soy proteins.

Sofos, J. N.

Dissertation Abstracts International, B 40 (2):609; Order no 79-18392, 267pp. (1979) [En] [Univ. of Minnesota, Minneapolis, Minnesota 55455, USA]

Studies were conducted on control of *Clostridium botulinum* by NaNO_2 in all-meat emulsions (beef, pork, chicken meat), meat/soy protein products, and all-soy protein products. Samples were inoculated with a composite heat-shocked spore inoculum of 5 type A and 5 type B strains. Inoculated samples were cooked to a final internal temp. of 68.5°C, incubated at 27°C, and checked after various intervals for growth of *Cl. botulinum* and toxin production. Nitrite levels ≤ 80 mg/g did not significantly delay toxin production.

156 mg nitrite/g delayed toxin production in all substrates except soy isolates. 0.2% sorbic acid delayed toxin production in all meats, but was ineffective in all-soy formulations. Combinations of nitrite (40–156 mg/g) with sorbic acid (0.2%) significantly delayed toxin production in all substrates. These nitrite/sorbic acid effects were greatest for all-soy formulations, followed by soy-meat blends; nitrate/sorbic acid effects were least in mechanically-deboned poultry meat preparations. Spore germination was inhibited by sorbic acid, alone or in combination. Sorbic acid effects increased with decreasing pH. Presence of sorbic acid reduced residual nitrite depletion, during product abuse. Residual nitrite depletion was slower in soy protein-containing formulations, especially those containing textured soy protein. Total microbial growth was little influenced by soy protein, nitrite and sorbic acid, at similar pH. Gas production and spoilage were good but not adequate indicators of *Cl. botulinum* toxin production. AJDW

99

[Use of reduced amounts of nitrite in the production of typical Italian salami.]

Baldini, P.; Farina, G.; Palmia, F.; Parolari, G.; Raczynski, R. G.

Industria Conserve 54 (4) 302–304 (1979) [3 ref. It, en]

[Sta. Sperimentale ner l'Ind. delle Conserve Alimentari, Parma, Italy]

A method was studied for preparing Italian salami with reduced amounts of NO_2^- . Slight dehydration (9% wt. loss) during a few days refrigerated storage of meat at 0° to 3°C and storage of the prepared mixture at 0° or –4°C resulted in inhibition of clostridia in the presence of only 50 p.p.m. NO_2^- (1–2 decimal reductions). Addition of small amounts of acetic acid (0.25–1.00 p.p.m.), which left the pH unchanged, caused reduction in counts of Enterobacteriaceae in salami containing $\leq 2.5\%$ NaCl; this effect was enhanced at low storage temp. and pH (4°C, 5.5). During drying and ripening, acetic acid prevented, sometimes only in part, the growth of enterobacteria in salami containing no added sugar. No growth of clostridia was observed (max. count 9/g). No increase in counts of pathogenic *Staphylococcus aureus* (inoculated into the mixture at 10^4 /g) occurred during 40 days' drying and ripening at <20°C (decreasing from 19° to 14°C between day 1 and 5, 12°C on days 6–40). AS

100

[Nitrate and nitrite in raw and cooked cured meat products.] Nitrit und Nitrat in erhitzten und rohen gepökelten Fleischerzeugnissen.

Wirth, F.

Fleischerei 31 (1) 21–24, V–VI (1980) [De, en, fr, es] [Inst. für Tech., Bundesanstalt für Fleischforschung, D-8650 Kulmbach, Federal Republic of Germany]

The use of nitrate and nitrite in curing of meat products is discussed, with reference to: toxicity and possible carcinogenicity of nitrite; nitrosamine formation in foods and in the alimentary tract; curing action of nitrate and of nitrite; nitrite concn. required for development of typical cured flavour and colour;

nitrite concn. required for microbiological safety; the potential for reduction of nitrite concn. used, especially in combination with added ascorbate; the possibility of elimination of use of nitrate; and problems with persistence of relatively high nitrate and nitrite levels in cooked cured products. Tables of data are given for residual nitrate and/or nitrite concn. in cured meat products made by various methods. AJDW

101

Role of nutrition on poultry carcass quality. [Review] Narahari, D.

Poultry Guide 17 (3) 23–26 (1980) [14 ref. En] [Dep. of Poultry Sci., Madras Vet. Coll., Madras, Tamil Nadu, India]

The effects of added fat in the diet of poultry on carcass quality are reviewed, in some detail, together with effects of some minerals (Ca and Mo), vitamin A and carotenoids, and drugs (e.g. coccidiostats). CFTRI

102

[Animal feeding trials on the relationship of nitrites to cancer.]

Billon, J.

RTVA 18 (148) 40–41 (1979) [8 ref. Fr] [Lab. Cent. d'Hygiène Alimentaire, 43 Rue de Dantzig, 75015, Paris, France]

Recent animal feeding studies suggesting a carcinogenic effect of dietary nitrite (not due to nitrosamine formation) are briefly discussed with reference to implications for use of nitrite as a food additive, and the danger of growth and toxin formation by *Clostridium botulinum* in meat products made with little or no nitrite. Conversion of dietary nitrate to nitrite is also considered, together with nitrosamine formation. AJDW

103

[Possibility of reducing additions of nitrite and nitrate to meat products.] Möglichkeiten zur Verringerung des Zusatzes von Nitrit und Nitrat bei Fleischerzeugnissen. [Lecture]

Mirna, A.

Proceedings of the European Meeting of Meat Research Workers No. 24, W5:1–W5:5 (1978) [14 ref. De, en, fr, ru] [Bundesanstalt für Fleischforschung, Kulmbach, Federal Republic of Germany]

It is considered in this review-type article that there is at present no known compound capable of complete replacement of nitrite or nitrate in meat products; that to restrict as far as possible formation of N-nitrosamines, reduction of nitrite addition is essential, a content of 0.35–0.45% NaNO_2 in nitrite curing salts being considered sufficient; and that simultaneous addition of ascorbic acid or sodium ascorbate is to be recommended. [See FSTA (1980) 12 8S1280.] SKK

104

Effect of nitrate, nitrite and a starter culture on the growth of *Yersinia enterocolitica* in dry sausage. [Lecture]

Raevuori, M.; Nurmi, E.; Hill, P.

Proceedings of the European Meeting of Meat Research Workers No. 24, K2:1-K2:5 (1978) [12 ref. En, de, fr, ru] [Dep. of Food Hygiene, State Vet. Med. Inst., Helsinki, Finland]

Dry sausages were made from a sausage mix consisting of 47% beef, 24% pork, 25% fat, 3% NaCl, 0.6% glucose and 0.4% seasoning. The mix was contaminated with either *Y. enterocolitica* (YE) strain ATCC 27729 from the American Type Collection or strain UCLA 151 from the California State Department of health, both being human clinical isolates, at 10^5 - 10^6 bacteria/g. To portions of each type of contaminated mix, (except controls), 150 mg NaNO_2 , or 300 mg KNO_3 , or Duploferment 66 (Rudolf Müller & Co., Giessen, Federal Republic of Germany) micrococci/lactobacilli starter at 10 ml final dilution + 150 mg NaNO_2 , or + 300 mg KNO_3 were added/kg. Contents of YE, micrococci and lactobacilli, and the pH and water activity (a_w), were measured on days 0, 3, 7 and 15 of ripening and drying. The results are tabulated. YE counts decreased in all samples during the process, the decrease being more rapid in the samples with added nitrite or nitrate and most rapid when starter was also included. For the 2 batches inoculated with the 2 strains of YE only, YE counts were 10^3 /g after 7 days, and $<10^2$ /g after 15 days. [See FSTA (1980) 12 8S1280.] SKK

105

Drinking water. Determination of fluoride and nitrate contents.

Oman, Ministry of Commerce & Industry
Omanian Standard OS 17/1979, 7 + 9pp. (1979) [En, Ar]

A colorimetric method, using zirconium-alizarin reagent, is specified for detn. of fluoride content of drinking water, and the brucine method is specified for detn. of nitrate content. AL

106

[Simultaneous determination of nitrates and nitrites in foods.]

Bellomonte, G.; Giammarioli, S.; Massetti, N.; Gaudiano, A.

Rivista della Società Italiana di Scienza dell'Alimentazione 8 (6) 349-352 (1979) [15 ref. It, en] [Lab. degli Alimenti, Istituto Superiore di Sanita, Rome, Italy]

A procedure for detn. of nitrite and nitrate in aqueous extracts of foods is described. Nitrite in the extract is determined by colorimetry at 538 nm, after diazotization with sulphanilamide/N(1-naphthyl) ethylenediamine. For detn. of nitrate, the extract is passed through a Cd column (to convert nitrate to nitrite), and the total nitrite concn. (preformed nitrite + nitrite formed from nitrate) is determined as above. Data are given for nitrite and nitrate concn. in various foods; nitrate concn. (dry wt. basis) ranged from 2.8 p.p.m. (apples, and pineapple with egg custard) to 486.0 p.p.m. (veal with carrots). Nitrite was present only at trace concn. in the samples studied. Detection limit was 0.5 p.p.m. nitrite and 1.0 p.p.m. nitrate. Reproducibility is satisfactory. AJDW

107

Effects of chemical treatments and controlled atmospheres on postharvest nitrate-nitrite conversion in spinach.

Aworh, O. C.; Hicks, J. R.; Lee, C. Y.; Minotti, P. L.
Journal of Food Science 45 (3) 496-498, 501 (1980) [En] [Dep. of Food Tech., Univ. of Ibadan, Ibadan, Nigeria]

Various controlled atmospheres and chemical treatments on postharvest nitrate-nitrite conversion in fresh spinach (*Spinacia oleracea* L.) were investigated. Substantial nitrite accumulated in spinach held in low O_2 (1%) at 10°C for 10-15 days relative to that held in air. High CO_2 (15-18%) at 10°C reduced nitrite accumulation provided the storage period did not exceed 10 days. Nitrate reductase activity was reduced 80% in leaves held for 2 days at 10°C and could not be detected in leaves held for 5 days or longer. Leaves dipped in 1% or 5% dehydroascorbic acid and subsequently held for 15 days at 10°C showed signs of physiological injury and accumulated high levels of nitrite, particularly at the 1% concn., relative to water-dipped controls where some nitrite accumulated but no leaf injury was seen. Compared to a water dip, nitrite accumulation was somewhat lessened by dipping in a 500 p.p.m. chloramphenicol solution. Little conversion of nitrate to nitrite occurred in fresh spinach held dry. Nitrite-N levels >20 p.p.m. were found only in visibly decayed samples. IFT

108

Kale greens quality, vitamin retention and nitrate content as affected by preparation, processing, and storage.

Sistrunk, W. A.

Journal of Food Science 45 (3) 679-681 (1980) [En] [Dep. of Hort. Food Sci., Univ. of Arkansas, Route 11, Fayetteville, Arkansas 72701, USA]

Influence of blanching method, detergent, wash water vol., hydrocooling and storage of the canned product on quality and retention of nutrients and nitrates in kale greens was evaluated. Greens blanched in steam retained more ascorbic acid, riboflavin and nitrates, and darker liquor in the canned product. Dipping the raw product in detergent before washing resulted in lower nitrates and higher riboflavin. Low vol. sprays resulted in less physical breakage and better retention of carotene, nitrates, colour, and texture. Hydrocooling after blanching leached out more ascorbic acid, riboflavin, nitrates, and colour. Changes in quality and nutrients during processing and storage were affected by processing variables and significant interactions between variables. IFT

109

Sorbic acid inhibition of *Clostridium botulinum* in nitrite-free poultry frankfurters.

Huhtanen, C. N.; Feinberg, J.

Journal of Food Science 45 (3) 453-457 (1980) [En] [USDA E. Reg. Res. Cent., SEA-AR, 600 East Mermaid Lane, Philadelphia, Pennsylvania 19118, USA]

Chicken and turkey frankfurter emulsions and ground commercial frankfurters were treated with sorbic acid

or potassium sorbate together with several acidulating agents. These were inoculated with 400 spores/g of a mixture of 21 strains of *C. botulinum* (12 of type A, 9 of type B) and canned under vacuum in 208 × 107 Al tab cans. The cans were temp. abused at 30°C. Chicken emulsions with sodium acid pyrophosphate (used for commercial frankfurters) showed can swelling in 2 days; turkey emulsion cans swelled in 4 days. Mean swell times for chicken and turkey were, resp.: 7 and 15 days with 0.52% potassium sorbate and 13 and 35 days with 0.40% sorbic acid. Acidification of emulsions with H₃PO₄ or glucono-δ-lactone to a pH as low as 5.4 did not increase mean swell times; however, in combination with 0.4% sorbic acid mean swell times were increased over those with sorbic acid alone. Citric acid increased mean swell times in turkey but not in chicken emulsions. For poultry emulsions and poultry frankfurters commercially prepared with 0.2% sorbic acid, acidification with H₃PO₄ to pH 5.7 resulted in appreciable increases in mean swell times; 0.4% sorbic acid without H₃PO₄ was more effective. Indigenous microflora, causing gas production in the cans, were also inhibited by 0.4% sorbic acid and by H₃PO₄-acidified 0.2% sorbic acid. Finished frankfurters generally behaved the same as the emulsions in *C. botulinum* inhibition; however, they gave better protection than the emulsions when both were treated with 0.2% sorbic acid + H₃PO₄. IFT

110

[Problems with use of curing agents in meat products.] Zur Problematik der Anwendung von Pökelfstoffen bei Fleisch-Erzeugnissen. Kotter, L.; Schmidt, H. *Zeitschrift für Lebensmittel-Technologie und -Verfahrenstechnik* 31 (2) 53-56 (1980) [2 ref. De] [Inst. für Hygiene & Tech. der Lebensmittel tierischen Ursprungs, Univ. München, 8000 Munich 22, Federal Republic of Germany]

Use of nitrite and nitrate as curing agents in meat products is discussed, with reference to: problems with control of the nitrate content of cured meats; current legislation on use of nitrate in meat products in the Federal Republic of Germany; use of nitrite curing salt; inhibition of *Clostridium botulinum* by nitrite; nitrosamine formation in nitrite-containing foods; likely consequences of a reduction in the nitrite content of curing salt; restriction of use of nitrate; and control of the concn. of curing agents in the finished product (with reference to diffusion and degradation of curing agents, effects of meat-brine ratio, etc.). AJDW

111

Gas chromatographic determination of nitrite in foods as trimethylsilyl derivative of 1H-benzotriazole.

Tanaka, A.; Nose, N.; Watanabe, A. *Journal of Chromatography* 194 (1) 21-31 (1980) [13 ref. En] [Saitama Inst. of Public Health, Kamiokubo-Higashi, 639-1, Urawa, Saitama, Japan]

1,2-Diaminobenzene reacts with nitrite in acidic solution to form 1H-benzotriazole, which can be extracted into ethyl acetate. After evaporation of the

ethyl acetate, 1H-benzotriazole is determined as its trimethylsilyl derivative by GLC on a column of 15% SE-30 on Chromosorb G HP at 200°C with flame-ionization detection. The nitrite concn. is calculated from the peak height. Amounts of 0.5-10 µg of nitrite-N can be determined. For detn. of nitrite in foods, clean-up of the crude extracts by ion-exchange column chromatography allows satisfactory elimination of interferents and permits concn. down to 0.41 p.p.m. to be determined. The recovery of nitrite added to foods at the 4.1 p.p.m. level ranges from 94.6 to 98.7% and at the 8.2 p.p.m. level it ranges from 95.2 to 98.8%. The trimethylsilyl derivative of 1H-benzotriazole was identified as 1-trimethylsilylbenzotriazole by combined gas chromatographic-MS examination and NMR spectrometry. AS

112

[Effect of heating on binding of nitrite to myoglobin.] Renerre, M.; Rougie, P.

Annales de Technologie Agricole 28 (4) 423-431 (1979) [23 ref. Fr, en] [Sta. de Recherches sur la Viande, CRZV, INRA, Cent. de Recherches de Clermont-Ferrand, Theix, 63110 Beaumont, France]

Studies were conducted on binding of ¹⁵N-labelled nitrite to purified bovine myoglobin, NaNO₂ being added at a ratio of 100 mol/mol myoglobin. Nitrite/myoglobin binding was evaluated at room temp., and during heating at 72°C for 12 min or 1 h, or at 100°C for 30 min. Tables and graphs of results are given. 1 mol of myoglobin was found to bind 0.735 mol NO at ambient temp., 0.716 mol NO during heating for 12 min at 72°C, 0.968 mol NO during heating for 1 h at 72°C, and 1.31 mol NO during heating for 30 min at 100°C. The relation of denaturation of myoglobin to binding of NO is considered, together with the structure of the nitrosopigment formed. AJDW.

113

Determination of nitrate and nitrite in meat products by using a nitrate ion-selective electrode.

Choi, K. K.; Fung, K. W. *Analyst* 105 (1248) 241-245 (1980) [20 ref. En] [Dep. of Chem., Univ. of Hong Kong, Pokfulam Road, Hong Kong]

10 g of the meat under test are homogenized, and extracted with 80 ml borax buffer (pH 9) for 3 h in a Soxhlet apparatus. After making up to 100 ml with water, 20 ml extract are mixed successively with 5 ml of a solution of Al₂(SO₄)₃ (0.03M) in boric acid (0.06M), 1 ml of sulphamic acid solution (0.01M), 3 ml of Ag₂SO₄ (0.16M) in 33% NH₃ solution, and 1 ml of (NH₄)₂SO₄ solution (2.0M). After adjustment of pH to 3.3 ± 0.1 with conc. H₂SO₄, the nitrate concn. is determined potentiometrically using an Orion nitrate-sensitive electrode (Model 93-07) and an Orion double junction reference electrode (Model 90-02), by the standard additions method or the calibration graph method. Nitrite concn. are determined as above, except that the 0.01M sulphamic acid solution is replaced by 0.01M KMnO₄ solution, to oxidize nitrite to nitrate. Data are given showing effects of extraction pH on recovery of nitrate and nitrite. Measures to eliminate interference

by other anions are described. Results determined by this method and by spectrophotometry agreed well. Data are given for nitrite concn. in various cured meat products, determined by this method. Extractable nitrite concn. was found to decrease considerably after opening the pack or can. AJDW

114

Effect of processing variables on the methionine content of frankfurters.

Strange, E. D.; Benedict, R. C.; Miller, A. J.
Journal of Food Science 45 (3) 632-634, 637 (1980)
[En][USDA E. Reg. Res. Cent., SEA-AR, 600 East Mermaid Lane, Philadelphia, Pennsylvania 19118, USA]

Effects of processing and use of pro-and antioxidant additives on methionine content of frankfurters were examined. Emulsification and cooking-smoking had no significant effect on the methionine content, but high peroxide fat or sodium ascorbate lowered the methionine content of the raw emulsions, presumably by oxidation. Cooking-smoking acted to restore the methionine level. Interaction of spice and nitrite on methionine levels was significant. Cooking and/or spices reduced the peroxide numbers of the frankfurters. IFT

115

Symposium on quality of vegetables. [Conference proceedings]

Nilsson, T. (International Society for Horticultural Science) (Editor)

Acta Horticulturae No. 93, 444pp. (1979) [many ref. En]

Papers presented at a symposium arranged by the working group 'Quality of Vegetables' of the Vegetables Section of the International Society for Horticultural Science and held in Lund, Sweden, from the 11th to the 15th June, 1979 include: Harvest-time in relation to sowing-time of scorzonera (*Scorzonera hispanica* L.), by G. Vulsteke (pp. 101-112, 7 ref.); Quality of carrots after mechanized cropping, by V. S. Dyachenko (pp. 113-123); Conservation of tomato, sweet pepper and aubergines quality under mechanized harvesting, storage and sale, by A. E. Serdyukov & V. G. Emelin (pp. 125-132); Influence of exogenous factors on the quality and chemical composition of vegetables, by K. Mengel (pp. 133-151, 55 ref.); Regulation of nitrate accumulation in vegetables, by D. N. Maynard & A. V. Barker (pp. 153-162, 20 ref.); Genetical and plant breeding possibilities for improving the quality of vegetables, by W. H. Gabelman & S. Peters (pp. 243-270, 109 ref.); Micronutrients and the quality of tomato, by J. E. Hardh & E. Takala (pp. 361-365, 2 ref.); Protein fractions and amino acid patterns of some tomato varieties, by A. Wünsch (pp. 367-378, 6 ref.); Some effects of seed treatments on quality of celery (*Apium graveolens*), by P. I. Tiernan & F. S. MacNaedhe (pp. 413-423, 10 ref.); and Quality studies in cauliflower, by A. R. Persson (pp. 443-444, 2 ref.). A further 28 papers are abstracted separately and will appear in the FSTA Author Index under International Society for Horticultural Science [Vegetables Symposium]. JRR

116

[Results of investigations on nitrogen.]

Boon, R.

Agricultura, Belgium 27 (3) 331-382 (1979) [Nl, en, de, fr][Bodemkundige Dienst van Belgie, 3030 Heverlee-Leuven, Belgium]

The main results from 20 yr studies on N fertilization by the Belgian Pedological Service are reviewed. Investigations of the effects on the main crops showed that increasing N fertilization resulted in increased N content in the plants. High N doses, late application or growth restraining conditions often caused NO₃ accumulation in turnips, cabbages and mangolds. The sugar contents in sugar beets and starch contents in potatoes decreased with increasing N-fertilization. RM

117

Nitrate contents in carrots (*Daucus carota* L.) as influenced by fertilization. [Lecture]

Venter, F.

Acta Horticulturae No. 93, 163-172 (1979) [17 ref. En]
[Dep. of Veg. Crops, Tech. Univ. of Munich, D-8050 Freising-Weißenstephan, Federal Republic of Germany]

Carrots of the cv. 'Sperlings Frühbund' were grown on fen peat (12% organic matter, pH 7.1) and fertilized with 0, 100 or 200 kg N/ha as CaCN₂, Ca(NO₃)₂ or (NH₄)₂SO₄. Roots were harvested for nitrate analysis on 4 dates not less than 4 wk after the last fertilization. Increasing N fertilization significantly increased the level of nitrates in carrot roots for all treatments and harvest dates. CaCN₂ produced lower levels of nitrate in the roots than did the other forms. A further experiment was conducted using the cv. 'Tip Top' grown in sandy soil (organic matter 2.2%, pH 6.9) and fertilized with nitrate nitrogen at 0, 125 and 250 kg N/ha. Fertilizer treatment increased nitrate content significantly, differences between the 2 levels of treatment varied with the harvest date. N fertilization increased the carotene content of the carrot roots, but had no significant effect on the level of vitamin C. [See FSTA (1980) 12 11J1566.] JRR

118

The effects of some exogenous and endogenous factors on the accumulation of nitrate ions by carrot root. [Lecture]

Blanc, D.; Mars, S.; Otto, C.

Acta Horticulturae No. 93, 173-185 (1979) [En]
[Agron. & Plant Physiology Sta., INRA, 45 Boulevard du Cap, Antibes, France]

This paper deals with the effects of different parameters involved in plant N nutrition, on the nitrate content in the carrot root. Levels and forms of mineral N supply, light intensity, activity of leaves have been taken into account in factorial experiments. The effect of internal factors such as stage of development and varietal comportment has been tested. Results are discussed with a view to the improvement of the quality of root production with respect to their nitrate content. [See FSTA (1980) 12 11J1566.] AS

119

Influence of nitrogen fertilizing on blanched celery (*Apium graveolens* var. *Dulce*). [Lecture]
Vulsteke, G.

Acta Horticulturae No. 93, 187-195 (1979) [5 ref. En]
[Provinciaal Onderzoek- en Voorlichtingscent. voor Land- en Tuinbouw, Roeslare-Rumbeke, Belgium]

The influence of fertilization with different N forms (ammonium, sodium and calcium nitrate, urea, and ammonium sulphate) on the growth of blanched celery both as a main crop and following early potatoes was studied in field experiments. Fertilizers were applied in both solid and liquid forms at a rate of 150, 225 or 300 kg/ha. Plants from each treatment were canned and held in normal conditions for 3-4 months. The pH of the celery liquor was hardly influenced by fertilizer treatment, nor was the colour or texture affected by the form of the fertilizer, except that the highest levels of ammonium and sodium nitrate produced a worse colour. Taste of the canned celery was affected by the fertilization methods; in general the level of application and timing made little difference to the taste, although the highest amounts produced the worst taste. Nitrate content of the canned celery increased with increasing N fertilization in all forms, and the higher nitrate contents caused greater rates of detinning of the can, which in turn negatively affected the taste of the product. [See *FSTA* (1980) 12 11]1566.] JRR

120

[Nitrate in cheese - industrial aspects.] [Review]
Oterholm, A.

Meieriteknikk No. 6, 33-39 (1980) [32 ref. No] [NMS Forsokssenter, Voll, Norway]

This review, with 7 figures and 10 tables, discusses factors affecting butyric acid fermentation in cheese and examines the need for nitrate in Norwegian cheeses. When nitrate is added to pasteurized milk for cheesemaking, it is apparently reduced by xanthine oxidase to nitrite. Alternatives to nitrate for preventing butyric acid fermentation are discussed. These include: other salts, such as NaBO_3 ; *Streptococcus lactis* starter strains producing nisin; lysozyme; H_2O_2 ; reduction of the spore content of farm milk; and reduction of the spore content of cheese milk by bacterofugation. After consideration of these various alternatives it is concluded that at present there is a technical need for nitrate in cheeses such as Norvegia, Edam and Jarlsberg. The final section of the article examines the risks to consumers from nitrate in cheese, including the possible formation of nitrosamines; however, in those cases where nitrosamines have allegedly been detected in cheese, no relationship has been found with addition of nitrate to the cheese milk; and in any case nitrite in cheese (about 0.5 mg/kg) is found at much lower concn. than in many other foods and is rapidly broken down. ADL

121

An assessment of nitrite for the prevention of botulism. [Conference proceedings]
United States of America, Institute of Food Technologists

Food Technology 34 (5) 228-257 (1980) [many ref. En]

Papers presented at the symposium held during the Annual Meeting of the Institute of Food Technologists at St. Louis, Missouri, 10-13 June, 1979, included the following titles. Botulism from meat and poultry products - a historical perspective, by R. B. Tompkin (pp. 229-236, 257, 72 ref.). Factors influencing botulinal inhibition by nitrite, by L. N. Christiansen (pp. 237-239, 15 ref.). USDA's role and plans regarding use of nitrites in cured meats, by S. J. Butler (pp. 252-253). Balancing the risks regarding the use of nitrites in meats, by S. A. Miller (pp. 254-256, 1 ref.). 2 further papers are abstracted individually and are listed in the *FSTA* author index under **United States of America, Institute of Food Technologists [Nitrite Symposium]**. DIH

122

Effects of changes in the production and marketing of cured meats on the risk of botulism. [Lecture]
Cervený, J. G.

Food Technology 34 (5) 240-243 (1980) [26 ref. En]
[Res. & Dev. Dep., Oscar Mayer & Co., PO Box 7188, Madison, Wisconsin 53707, USA]

Since 1906, when the Federal Meat Inspection Act was passed in the United States of America, there have been significant changes in the formulation, processing and marketing of cured meat products. These changes are discussed in chronological order from the early 1900s to the 1970s. Formulation changes have included direct addition of nitrite, decrease in salt concn. and use of ascorbate (or isoascorbate) and phosphates. Processing developments have included improvements in refrigeration systems and in packaging methods and materials. Detailed consideration is given to the effects of these changes on the potential for cured meat products to cause botulism. A review of the available information indicates that modern refrigeration systems combined with the direct addition of nitrite have enabled cured meats to achieve and maintain an excellent public health record; the procedures and materials used in cured meat production are adequate for controlling *Clostridium botulinum*. However, further studies are recommended on the effect of phosphates on *Cl. botulinum* growth in bacon and ham. [See *FSTA* (1980) 12 11]15904.] JA

123

Alternatives to the use of nitrite as an antibotulinal agent. [Lecture]

Sofos, J. N.; Busta, F. F.

Food Technology 34 (5) 244-251 (1980) [many ref. En]
[Dep. of Food Sci. & Nutr., Univ. of Minnesota, St Paul, Minnesota 55108, USA]

Concern has been expressed for some yr about the use of nitrite as an antibotulinal agent in cured meats; this concern has arisen from reports implicating nitrite as a potential precursor of carcinogenic N-nitrocompounds in cured meats especially crisp-fried bacon. The main objective of this paper is to consider alternative means of botulinal control, but other topics are also covered including the functions of nitrite in cured meats and the mechanism of its antibotulinal activity. Reasons for the exemplary botulism safety record of commercially prepared cured meats in the USA are also discussed. The discussion of possible alternatives to nitrite considers: control of botulinal

outgrowth by dehydration, low temp. storage, thermal processing, and irradiation; the potential for an increased role in botulism prevention by ingredients currently permitted in cured meats (e.g. NaCl, acids, ascorbate or isoascorbate, polyphosphates, sugars and syrups, chelators or sequestering agents, antioxidants, smoke and its components, extenders, binders, seasonings); and other preservatives widely used in the food industry (e.g. methyl and propyl esters of parahydroxybenzoic acid, potassium sorbate, sorbic acid). To date no single alternative has been identified which could completely replace nitrite. The possibility of decreasing the nitrite level and adding sorbate has been extensively tested and appears promising. [See FSTA (1980) 12 11S1904.] JA

124

Combined effect of nitrite and chloride on the ultrastructure of meat by electron microscopy.

Fox, J. B., Jr.; Rorer, F. P.; Fiddler, R. N.; Carroll, R. J.; Wasserman, A. E.

Journal of Food Science 45 (4) 1056-1057, 1059 (1980) [En] [USDA E. Reg. Res. Cent., SEA-AR, 600 E. Mermaid Lane, Philadelphia, Pennsylvania 19118, USA]

Scanning electron microscopy of the ultrastructure of cured beef has shown that the combination of NaCl and nitrite effects changes in the interfibre spaces not caused by either salt alone. The effect is attributed to catalysis of the nitrosation reaction through the formation of the more powerful nitrosating species NOCl. IFT

125

Role of nitrite in cured meat flavor: sensory analysis.

MacDonald, B.; Gray, J. I.; Stanley, D. W.; Osborne, W. R.

Journal of Food Science 45 (4) 885-888, 904 (1980) [En] [Dep. of Food Sci., Univ. of Guelph, Guelph, Ontario, N1G 2W1, Canada]

Effect of varying levels of nitrite on the development of cured meat flavour in hams was investigated. Sensory evaluation studies demonstrated that concn. of sodium nitrite as low as 50 mg/kg developed a significant ($P < 0.05$) cured meat flavour. In addition, this level of nitrite was as equally effective as 500 mg nitrite/kg in retarding the development of off-odours and flavours during aerobic storage of hams for 7 days at 4°C. Reduced off-flavour formation was also observed in meat samples treated with 0.02% butylated hydroxytoluene or 1000 mg citric acid/kg although these compounds were not as effective as 50 mg nitrite/kg in producing a typical ham aroma or flavour. The intensity of cured meat aroma/flavour as well as overall palatability was found to be directly related to a decrease in off-odours/flavours present in the product. IFT

126

Role of nitrite in cured meat flavor: chemical analysis.

MacDonald, B.; Gray, J. I.; Kakuda, Y.; Lee, M. L.

Journal of Food Science 45 (4) 889-892 (1980) [En] [Dep. of Food Sci., Univ. of Guelph, Guelph, Ontario N1G 2W1, Canada]

Hams treated with 2.5% salt and varying concn. of sodium nitrite, butylated hydroxytoluene (BHT), and citric acid were evaluated by means of thiobarbituric acid (TBA) values, formation of fluorescent products, hexanal and 2,4-decadienal, and sensory analyses. Results demonstrate that nitrite significantly reduces ($P < 0.05$) lipid oxidation in pork stored aerobically at 4°C. Meat treated with 0.02% BHT or 1000 mg citric acid/kg also reduced TBA values, although these compounds were not as effective as 50 mg sodium nitrite/kg. A significant relationship ($P < 0.05$) was established between off-odour/flavour formation and both TBA values and the production of fluorescent products during the first 7 days of storage. However, the relationship between fluorescent products and off-odours/flavours was not significant at 14 days. Significantly lower ($P < 0.05$) levels of hexanal and 2,4-decadienal were found in meat treated with nitrite, BHT or citric acid compared to samples containing only salt. [See also preceding abstr.] IFT

127

Role of nitrite in cured meat flavor: antioxidant role of nitrite.

MacDonald, B.; Gray, J. I.; Gibbins, L. N.

Journal of Food Science 45 (4) 893-897 (1980) [En] [Dep. of Food Sci., Univ. of Guelph, Guelph, Ontario N1G 2W1, Canada]

The antioxidant activity of nitrite was investigated in model systems containing linoleic acid, Tween 20, and phosphate buffer. Results indicated that nitrite by itself can act as a prooxidant especially at concn. > 25 mg/kg. However, addition of nitrite to model systems containing prooxidants such as Fe^{2+} or Fe^{2+} -EDTA substantially reduced the rates of oxidation. Lipid oxidation catalysed by aqueous beef extract also showed a marked decrease upon addition of nitrite. Nitrite also produced a significant effect ($P < 0.05$) on haem-catalysed lipid oxidation although the nature of this effect was not established. Further studies with an aqueous extract of pork demonstrated that dialysis removes a fraction which is largely responsible for the catalytic effect of meat extracts on lipid oxidation. Trace metal analysis revealed the presence of Fe in the dialysates from these extracts. Nitrite may function as a metal chelator to tie up these trace metals present in meat. [See also preceding 2 abstr.] IFT

128

Consumer acceptability of turkey frankfurters with 0, 40 and 100 p.p.m. nitrite.

Sales, C. A.; Bowers, J. A.; Kropf, D.

Journal of Food Science 45 (4) 1060-1061 (1980) [En] [Dep. of Foods & Nutr., Kansas State Univ., Manhattan, Kansas 66506, USA]

Turkey frankfurter formulated with 0, 40 and 100 p.p.m. nitrite were evaluated for colour, flavour, and overall acceptability by a consumer panel and for rancid and cured meat flavour and aroma by a trained panel. In addition, consumer preference was evaluated by determining the number of frankfurters that consumers selected to eat from each of the 8 formulations. Panelists selected more frankfurters with 40 or 100 p.p.m. nitrite than they did frankfurters with 0 p.p.m. nitrite. In a paired comparison of frankfurters with 0 vs.

100 p.p.m. nitrite, more consumers preferred the colour of those containing 100 p.p.m. nitrite. Their preference did not differ for 40 vs. 100 p.p.m. frankfurters. Trained panelists found no significant difference in flavour and aroma of frankfurters containing 40 vs. 100 p.p.m. nitrite, but flavour and aroma of frankfurters containing no nitrite were significantly different from those of frankfurters containing nitrite. Rancid aroma and flavour decreased and cured meat aroma and flavour increased with increasing nitrite concn. Redness (a^+ values) increased with increasing nitrite concn. Samples containing no nitrite were significantly more yellow (b^+ values) than those containing nitrite. IFT

129

Bacterial inhibitory effects of nitrite: inhibition of active transport, but not of group translocation, and of intracellular enzymes.

Yarbrough, J. M.; Rake, J. B.; Eagon, R. G.
Applied and Environmental Microbiology 39 (4) 831-834 (1980) [21 ref. En] [Dep. of Microbiol., Univ. of Georgia, Athens, Georgia 30602, USA]

Nitrite inhibited active transport of proline in *Escherichia coli* but not group translocation of sugar via the phosphoenolpyruvate:phosphotransferase system. These results were consistent with previous results that nitrite inhibits active transport, O_2 uptake, and oxidative phosphorylation in aerobic bacteria. Nitrite also inhibited aldolase (EC 4.1.2.13) from *E. coli*, *Pseudomonas aeruginosa*, *Streptococcus faecalis*, and rabbit muscle. Thus, these various data showed that nitrite has more than one site of attack in the bacterial cell, and also indicated that nitrite is inhibitory to a wide range of physiological types of bacteria. AS

130

[Exposure of the Swiss population to nitrate in foods.] Die Belastung der schweizerischen Bevölkerung mit Nitraten in der Nahrung.
Trempe, E.

Mitteilungen aus dem Gebiete der Lebensmitteluntersuchung und Hygiene 71 (2) 182-194 (1980) [39 ref. De, en, fr] [Bundesamt für Gesundheitswesen, Berne, Switzerland]

The significance of various foods as sources of nitrate in the diet in Switzerland is discussed, with reference to estimates of daily nitrate intake based on data for the annual consumption and nitrate concn. of various foods. It is calculated that average nitrate intake is 91 mg/day; approx. 70% of this is from vegetables and approx. 21% from water and other beverages. Of vegetables, lettuce and spinach are the main sources of nitrate. Data for per capita intake of nitrate in Switzerland are compared with literature data for other countries. The very high nitrate intake which may be reached by people with a high vegetable consumption, and living in an area with nitrate-rich drinking water, is briefly considered. AJDW

131

Ins and outs of nitrites.

Tannenbaum, S. R.
Sciences 20 (1) 7-9 (1980) [En]

Dietary and environmental sources of nitrite and nitrate in conjunction with the healthy body's natural production of nitrite and nitrate and the subsequent endogenous synthesis of these products into nitroso-carcinogenic substances are discussed. SP

132

[Nitrate in foods. The current situation.] Nitrate in Nahrungsmitteln, eine Standortbestimmung. [Review] Biedermann, R.; Leu, D.; Vogelsanger, W.
Deutsche Lebensmittel-Rundschau 76 (5) 149-156; (6) 198-207 (1980) [181 ref. De, en, fr] [Kantonales Lab., CH-8204 Schaffhausen, Switzerland]

Aspects considered in this review include: toxicology of nitrates, nitrites and nitrosamines; epidemiology of dietary nitrate in relation to cancer of the stomach; daily nitrate intake in dependence on food consumption patterns; the origin of nitrate in vegetables, cereals and feed crops; the origin of nitrate in the soil, ground water and drinking water; use of nitrate as an additive; measures for reduction of nitrite concn. in foods; and legal aspects. AJDW

133

Levels of nitrate and nitrite in casein products using an automated procedure.

Woollard, D. C.; Forrest, L. J.
New Zealand Journal of Dairy Science and Technology 15 (1) 83-90 (1980) [10 ref. En] [Auckland Reg. Dairy Lab., Min. of Agric. & Fisheries, Auckland, New Zealand]

The method consists of dissolving 1 g lactic casein in 9.2 ml NH_4Cl buffer at pH 9.6, or 1 g rennet casein in 2% sodium tripolyphosphate to a final concn. of 1:10 w/v. Standard solutions of NO_2^- and NO_3^- are prepared in buffer solutions of casein containing low natural levels of NO_2^- and NO_3^- . A Cd column (with the Cd 'copperized' with $CuSO_4$ prior to use) is used to reduce NO_3^- to NO_2^- which is then determined colorimetrically (after diazotization with sulphanilamide) in a Technicon Auto Analyzer II. Results of analyses of 10 casein samples by the automated procedure were similar to those obtained by a manual procedure involving the same reaction principles except that the Cd was not copperized. During the 1978/79 dairy season in New Zealand, 483 casein samples were tested by the automated procedure. Mean NO_3^- content was 12.7 $\mu g/g$; no NO_2^- was detected in any of the samples. Examination of caseins made at 4 different plants showed that the NO_3^- content was constant for a given plant, suggesting that the source of contamination was environmental. Reasons for occasional high levels of NO_3^- have yet to be determined. MEG

134

[Aeration and oxidation of nitrites in meat products.] Cantoni, C.; Paleari Bianchi, M. A.; Beretta, G.
Industria Alimentari 19 (3) 224-225 (1980) [9 ref. It, en] [Istituto di Ispezione degli Alimenti di Origine Anim., Univ. degli Studi di Milano, Milan, Italy]

Chemical reactions involved in the use of nitrates and nitrites in the processing of meat products are surveyed. A spectrometric study of the transformation of sodium nitrite into NO_2 with a Griess reagent in the presence of

a stream of O₂ (vs. N₂) at different speeds (156, 270 and 1500 ml/min) was carried out. Results (tabulated) showed that the faster the O₂ flow, the more NO₂ was formed, confirming the postulated explanation of the darkening phenomenon observable in meat products (especially pancetta) dried in high speed air currents: i.e. nitrate additions are ineffective, as the nitroso pigments which maintain the red colouring cannot be formed.
KME

135

[Colour of raw ripened sausages.]

Cantoni, C.; Paleari Bianchi, M. A.; Beretta, G.; Perlasca, M.

Industrie Alimentari 19 (3) 214-215 (1980) [1 ref. It, en]

[Istituto di Ispezione degli Alimenti di Origine Anim., Univ. degli Studi di Milano, Milan, Italy]

In a study on prepared meats, in the curing of which nitrates and nitrites are used for colour stabilization, 3 samples of salami of neutral (6.0), moderately acid (5.4) and acid (5.0) pH were examined for colour concn. at 6-day intervals (from 0-60 days) by spectrophotometry. Results (graph) showed a drastic diminution of optical density with increasing acidity. It is concluded that in salami at neutral pH, colour intensity may be attributed to formation of nitrosomyoglobins, but at acid pH, haem and nitrosohaem compounds are formed and the salami is less easily oxidized. KME

136

[Reduction of the residual nitrite and nitrate contents of raw dry sausages.] Untersuchungen zur Senkung des Restnitrit- und Nitratgehaltes in Rohwürsten. [Thesis] Wenderdel, B.

88pp. (1978) [66 ref. De, en] Hanover, Federal Republic of Germany; Tierärztliche Hochschule

Studies were conducted on curing of conc. blood, manufacture of raw dry sausages containing conc. haemolysed blood, and effects of haemolysed conc. blood, sodium ascorbate and glucono- δ -lactone (G- δ -L) on the residual nitrate and nitrite concn. in raw dry sausage. Numerous tables and graphs of results are given. Studies on curing of conc. blood showed that addition of NO₂⁻ resulted in cured colour formation; residual nitrite concn. were reduced by addition of ascorbate. Residual nitrite concn. were higher in dilute than in conc. blood similarly treated. Addition of 3 g nitrite curing salt to 100 g conc. blood gave no cured colour formation. Formation of nitrate from nitrite in cured blood was variable. G- δ -L gave a rapid initial decline in pH; ascorbate and starter cultures gave a slower pH decline. Addition of G- δ -L eliminated residual nitrite within 2 days. Samples made with sodium ascorbate and starter cultures contained detectable nitrite for ≤ 10 days. Nitrate concn. decreased rapidly in samples made without G- δ -L, slowly in those with G- δ -L. Addition of conc. blood had little effect on residual nitrate or nitrite concn. AJDW

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FAB 48

NITRATES AND NITRITES IN MEAT PRODUCTS

SELECTED FROM VOLUME **13**

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under the direction of:-

Commonwealth Agricultural Bureaux, Farnham Royal, Slough; Gesellschaft für Information und Dokumentation, Frankfurt am Main; Institute of Food Technologists, Chicago; Centrum voor Landbouwpublikaties en Landbouwdocumentatie (Pudoc), Wageningen.

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H. BROOKES

EDITOR

1

Determination of nitrite at parts-per-billion levels by derivatization and electron capture gas chromatography.

Funazo, K.; Tanaka, M.; Shono, T.

Analytical Chemistry 52 (8) 1222-1224 (1980) [27 ref. En][Dep. of Applied Chem., Fac. of Eng., Osaka Univ., Yamada-kami, Suita, Osaka 565, Japan]

Nitrite is first converted, by reaction with *p*-bromoaniline and copper(II) chloride in a HCl medium, into *p*-bromochlorobenzene which is then extracted into toluene and determined by gas chromatography with electron capture detection. The detection limit for nitrite with this method is 0.01 p.p.m., which is as low as that of the widely used colorimetric method. The method is not affected by such inorganic ions as Cl^- , Br^- , F^- , NO_3^- , H_2PO_4^- , SO_4^{2-} , HCO_3^- , K^+ , Na^+ , Mg^{2+} , and NH_4^+ , which commonly coexist with nitrite in environmental and biological samples. A variety of samples containing nitrite, i.e. river water, human saliva and foods (ham, sausage, fish sausage), were analysed by both the gas chromatographic and colorimetric methods. Good agreement was found between the methods. AS

2

Reduction of nitrate and nitrite in foods by lactic acid bacteria. (In 'Proceedings from the first biennial Marschall International Cheese Conference' [see FSTA (1981) 13 1P59]) [Lecture]

Speck, M. L.

pp. 387-390 (undated) [8 ref. En][Dep. of Food Sci. & Microbiol., N. Carolina State Univ., Raleigh, N. Carolina 27650, USA]

Sources of nitrates and nitrites (precursors of nitrosamines) in human nutrition are outlined and the role of lactic acid bacteria in the reduction of these compounds in cheese and bacon is discussed. Finally, the possibility of the involvement of lactobacilli in the prevention of nitrosamine formation in the intestinal tract is indicated. FL

3

[Influences on nitrate contents of lettuce (*Lactuca sativa* L. var. *capitata* L.).] Einflüsse auf den Nitratgehalt von Kopfsalat (*Lactuca sativa* L. var. *capitata* L.). [Lecture]

Venter, F.

Landwirtschaftliche Forschung Sonderheft 35, 616-622 (1979) [37 ref. De, en, fr][TU München, D-8050 Freising-Weihenstephan, Federal Republic of Germany]

Effects of the form and level of N fertilization, illumination and harvesting date on NO_3^- contents of lettuce were studied in glasshouse and field trials. Results showed increasing NO_3^- contents with rising N fertilization. Harvesting data had no effect. NO_2^- contents were 50% higher in glasshouse-grown plants in poor light than in open fields, and were higher in plants grown in the shade than in the sun. The leaf veins and stems contained about twice as much NO_3^- as the inner leaves. [See FSTA (1981) 13 1A3.] RM

1

4

Inhibition of botulinum toxin formation in bacon by acid development.

Tanaka, N.; Traisman, E.; Lee, M. H.; Cassens, R. G.; Foster, E. M.

Journal of Food Protection 43 (6) 450-457 (1980) [17 ref. En][Food Res. Inst., Univ. of Wisconsin, Madison, Wisconsin 53706, USA]

Lactobacillus plantarum, as a producer of lactic acid, and sucrose as a fermentable carbohydrate were evaluated for use in lowering the amount of, or eliminating sodium nitrite in bacon. This work was limited to effect on antibotulinal properties. Organoleptic effects were not considered. Slices of bacon were inoculated with spores of *Clostridium botulinum* types A and B with or without simultaneous inoculation with a culture of *L. plantarum*, vacuum-packaged and incubated at 27°C. Samples were taken after various periods of incubation and assayed for botulinal toxin. It was found that sodium nitrite alone, at 120 p.p.m., did not give bacon extended protection against development of botulinum toxin if a fermentable carbon source (sucrose in these instances) was not present; without added lactic acid bacteria, the effectiveness of 120 p.p.m. of sodium nitrite plus sugar was variable and depended upon growth of naturally contaminating bacteria and lactic acid bacteria with an adequate amount of sucrose gave good protection against development of botulinal toxin. Upon temp. abuse, acid was produced and growth of *C. botulinum* was inhibited. Because the protective properties against development of botulinal toxin in the sugar-lactic acid bacteria system were not dependent on the presence of nitrite, nitrite can be lowered to the level necessary to make organoleptically acceptable products without sacrificing safety, thus less nitrosamine formation may be achieved. AS

5

Reduction of sodium nitrate and nitrite during curing and smoking poultry meat.

Singh, R. P.; Mahadevan, T. D.

Indian Journal of Poultry Science 14 (4) 181-184 (1979) [10 ref. En][Div. of Poultry Res., Indian Vet. Res. Inst., Izatnagar-243 122, India]

Dressed, cut-up chicken was cured for 72 h at 5-6°C (RH 80-85%), and smoked in hardwood smoke for 4 h at 40-45°C (RH 25-30%); it was then stored at room temp. (25-26°C) and under refrigeration (5-6°C). On the 4th day of storage, nitrite content was found to have increased significantly in all the treatments, the increase being greatest under refrigerated storage. On the 8th day of storage, a significant decrease in nitrite content was observed both before and after cooking, the loss being greater in the samples stored at room temp. The cured and smoked chicken had a desirable colour, flavour, and taste. CFTRI

6

Antibotulinal efficacy of sulfur dioxide in meat.
Tompkin, R. B.; Christiansen, L. N.; Shaparis, A. B.
Applied and Environmental Microbiology 39 (6)
1096-1099 (1980) [28 ref. En] [Swift & Co., Res. &
Development Center, Oak Brook, Illinois 60521, USA]

The addition of sodium metabisulphite as a source of SO_2 delayed botulinal outgrowth in perishable canned comminuted pork when it was temp. abused at 27°C. The degree of inhibition was directly related to the level of SO_2 . Levels of $> 100 \mu\text{g SO}_2/\text{g}$ were necessary to achieve significant inhibition when a target level of 100 botulinal spores/g was used. Sodium nitrite partially reduced the efficacy of the SO_2 . SO_2 offers a new option for the control of botulinal outgrowth in cured or noncured meat and poultry products. AS

7

[Redox potential of fresh ham cured with NaCl alone, or with nitrite.]

Wiberg, C.; Nilsson, G.

Var Föda 32 (3) 139-143 (1980) [8 ref. Sv. en] [Biol. Lab., Statens Livsmedelsverk, S-751 26 Uppsala, Sweden]

Studies were conducted on the redox potential and pH of (i) hams cured in 12% NaCl brine for 9-16 days, and (ii) hams cured in a 12% brine made from salt containing 0.6% nitrite for 10-18 days. Data are given for the hams before and after boiling. For raw samples, mean Eh value of (i) was -220 mV , vs. $+74 \text{ mV}$ for (ii); corresponding pH values were 5.65 for (i) and 5.78 for (ii). For boiled samples, redox potential was -137 mV for (i) and -114 mV for (ii); corresponding pH values were 6.06 and 6.20 resp. AJDW

8

[Nitrates and nitrites in vegetable products.]

Pallotti, G.; Bencivenga, B.; Colaiori, G.; Consolino, A.; Porrozzi, G.

Industria Alimentari 19 (6) 495-498 (1980) [28 ref. It, en] [Lab. Chimico Provinciale, Rome, Italy]

Deep frozen leaf spinach (980 p.p.m. NO_3), ground spinach (710 p.p.m. NO_3) and broccoli (1210 p.p.m. NO_3) were stored at ambient temp. for 8 days or at 4°C for 40 days. At ambient temp., max. nitrite contents of the vegetables were 108, 50 and 12 p.p.m., resp. (reached after 1, 6 and 7 days, resp). At 4°C, corresponding max. NO_2^- levels were 375, 75 and 50 p.p.m. (reached after 24, 28 and 13 days, resp.). When deep-frozen spinach (initial nitrate concn., 1120 mg/kg) was (i) cooked under pressure or (ii) in water and stored at ambient temp. or 4°C, no nitrites were found in (ii) samples at either storage temp., none in (i) samples at 4°C, and 300-390 mg/kg in the (i) samples at ambient temp. after 4-5 days (only 255 mg/kg when fresh spinach was used). Deep-frozen samples of spinach and broccoli were also stored at -18°C for 60 days, with 90 min or 12 h suspensions of power to simulate power failure. No nitrites were detected in the samples. HBr

[Studies on nitrate and nitrite in horticultural products. VIII. Nitrate and nitrite contents in some vegetable pickles.]

Hata, A.; Ogata, K.

Journal of Japanese Society of Food Science and Technology [Nippon Shokuhin Kogyo Gakkaishi] 26 (1) 6-12 (1979) [Ja, en] [Fac. of Living Sci., Kyoto Prefectural Univ., Simogamo, Kyoto-shi, Kyoto-fu, Japan]

Nitrate contents of cabbage (CB) and chinese cabbage (CC) decreased during pickling with salt and the content in the drip of their pickles increased and finally both contents attained equilibria 3 days after pickling for CB and 4 days for CC. After the equilibria, nitrate contents in CB and the drip gradually increased, but nitrate contents in CC pickles were constant. Nitrite concn. drastically increased from non-detectable to a max. 5 days after pickling for CB (max. 108 p.p.m.), 4 days after pickling for CC (max. 260 p.p.m.) and thereafter declined rapidly to the initial level. Addition of alcohol to CC pickles with salt depressed nitrite production (max. 125 p.p.m.), and addition of acetic acid to CB pickles inhibited nitrite production completely. Nitrate and nitrite contents of seisai (*Brassica* sp.) during storage of pickles with salt changed in a similar manner to CB and CC, but max. nitrite content was relatively low (5-10 p.p.m.). In pickles of CB and CC with salt-bran, nitrate contents of these vegetables decreased during storage, but the contents in salt-bran increased very slowly. Nitrite production of the vegetables was lower than that of pickles with salt. No difference in nitrate contents between cucumber pickles in the salt-bran with ascorbate and without ascorbate was observed. A large variation of nitrate contents was observed ranging from 13 p.p.m. (cucumber pickles in salt-bran) to 1491 p.p.m. (hinona - a kind of turnip in salt) in market pickles. Nitrite contents were low in market pickles, except 259 p.p.m. in turnip pickles. [See FSTA (1980) 12 3]295 for part VII and following abstr. for part IX.] AS

10

[Studies on nitrate and nitrite in horticultural products. IX. Relationship between nitrate content and some enzymic activities in spinach and squash during storage.]

Hata, A.; Chachin, K.; Ogata, K.

Journal of Japanese Society of Food Science and Technology [Nippon Shokuhin Kogyo Gakkaishi] 26 (4) 180-188 (1979) [Ja, en] [Fac. of Living Sci., Kyoto Prefectural Univ., Simogamo, Kyoto, Japan]

Activities of nitrate reductase, nitrite reductase, some dehydrogenases and glutamine synthetase in spinach (*Spinacia oleracea* cv. New Asia) and squash (*Cucurbita moschata* cv. Kogiku) were examined in relation to changes in nitrate contents during storage. Methods of maintaining nitrate reductase activity in spinach during storage to reduce nitrate content were also studied. There were no significant changes in nitrate content of spinach during storage, and activity of nitrate reductase declined markedly during stages of storage. Nitrate content of squash decreased gradually during the early stages of storage and decreased sharply during the later stages. Activity of nitrate reductase in squash increased

gradually during storage. Activity of nitrite reductase was almost constant in both spinach and squash during storage. Some dehydrogenases, which form NADH or NADPH, used by nitrate reductase or nitrite reductase, were analysed in both materials during storage. In spinach, activities of glucose-6-phosphate dehydrogenase, malic enzyme, glyceraldehyde-3-phosphate dehydrogenase and glutamine synthetase decreased during storage. In squash, dehydrogenases activity increased during storage. Effect of gas treatment or packaging film on nitrate content of spinach during storage was studied. Treating with 100% CO₂ and packaging in polyethylene bags did not affect nitrate content. Treating with 100% N₂ reduced nitrate content in leaf blade of spinach and kept nitrate reductase activity high; a slight accumulation of nitrite was observed. Treating with 1% propyl alcohol, N⁶-BA (0.1 mM), and cyclic AMP (0.1 mM) inhibited the decrease in nitrate reductase activity during storage of spinach. [See preceding abstr. for part VIII.] AS

11

[Nitrate, nitrite and nitrosamines in foods. Improved production hygiene as an alternative to use of nitrite.] [Review]

Skovgaard, N.

Nordisk Veterinaermedicin 32 (9) 387-399 (1980)

[37 ref. Da, en] [Inst. for Vet. Mikrobiologi & Hygiejne, Den Kongelige Vet. & Landbohøjskole, Copenhagen, Denmark]

Aspects considered in this review include: the relationship between microbial count and keeping quality of foods; effects of environmental conditions on microbial growth; the significance of resistance of bacteria to preservatives; counts of spores (especially *Clostridium botulinum* spores) in foods; the implications of the spore count for effects of nitrite in heat-treated meat products; necessary nitrite concn. for inhibition of *Cl. botulinum* and saccharolytic clostridia; formation of nitrite from nitrate; potentiating and antagonistic effects of other additives or constituents (ascorbate, isoascorbate, sorbate, phosphate, Fe) on effects of nitrite in meat products; application and effects of nitrite in raw, cured and refrigerated meat products; and advantages of low initial counts in foods to be preserved with nitrite (i.e. lower nitrite concn. required). AJDW

12

Analytical errors resulting from nitrate contamination of filter paper.

Muneta, P.

Journal of the Association of Official Analytical Chemists 63 (4) 937-938 (1980) [5 ref. En] [Dep. of Bact. & Biochem, Univ. of Idaho, Moscow, Idaho 83843, USA]

Certain brands and grades of filter paper can contribute significant errors up to 20-30 p.p.m. nitrate N in the nitrate analysis of cured meats. Filter paper for qualitative filtration contained the largest quantity of nitrate. The brand of filter paper determined the nitrate extracted from the filter paper. Low ash or ashless quantitative filter paper contained no nitrate, except 1 box, from which a very small quantity of nitrate was extracted. AS

Relationship between the increased sensitivity of heat injured *Clostridium perfringens* spores to surface active antibiotics and to sodium chloride and sodium nitrite.

Chumney, R. K.; Adams, D. M.

Journal of Applied Bacteriology 49 (1) 55-63 (1980) [21 ref. En] [Dep. of Food Sci., N. Carolina State Univ., Raleigh, N. Carolina 27650, USA]

Studies were conducted on inhibition of heat-activated and heat-injured spores of *Clostridium perfringens* NCTC 8798 by NaCl (2.0-4.3%), NaNO₂ (0.02-0.05%) or a mixture of 20 µg polymyxin (PM) and 50 µg neomycin (NM)/ml medium. Data are presented for % recovery of heat activated spores, and spores subjected to heat treatment at 70-100°C, inhibition of heat-injured spores by the agents studied, alone or in combination, and for effects on repair of thermal injury, in the presence of substances inhibiting macromolecular synthesis (nalidixic acid, tetracycline, D-cycloserine). PM/NM, NaCl and NaNO₂ had little effect on colony counts of heat-activated spores, but reduced recovery rate of spores heated at 90°C for 6 h by 78-99%, suggesting that the spores underwent heat damage increasing sensitivity to these agents. Level of inhibition and apparent % of injured spores increased with increasing NaCl or NaNO₂ concn., and increasing temp. No synergistic action between PM/NM, NaCl and NaNO₂ was observed. The macromolecular synthesis inhibitors did not affect repair of heat damage to spores. It is concluded that the same type of cell damage was responsible for the effects of heat damage on sensitivity to PM/NM, NaCl and NaNO₂. AJDW

14

Volatile nitrosamines in human blood before and after ingestion of a meal containing high concentration of nitrate and secondary amines.

Yamamoto, M.; Yamada, T.; Tanimura, A.

Food and Cosmetics Toxicology 18 (3) 297-299 (1980) [15 ref. En] [Nat. Inst. of Hygienic Sci., Setagaya-ku, Tokyo, Japan]

In order to assess the effects of the Japanese diet on the levels of nitrosamines in the blood, a meal containing high levels of nitrate and secondary amines was consumed by 8 Japanese volunteers. The meal consisted of rice, roasted mackerel, roasted cod roes, pickled radishes, dried strips of radishes, soup containing fish balls and salted Chinese cabbage. Levels of nitrosamines were studied in blood samples taken before and after ingestion of the meal. Nitrosodimethylamine was detected in all 32 blood samples from 8 donors in amounts ranging from a trace (<0.5 ng/ml) to 1.3 ng/ml. The results did not show any clear effects of the meal on the levels of nitrosamines in the blood at least for periods up to 2 h after the meal. The results suggest the possibility of nitrosamine formation in the lower gastro-intestinal tract. VJG

15

Effect of betel-quid chewing on nitrite levels in saliva.

Shivapurkar, N. M.; D'Souza, A. V.; Bhide, S. V.
Food and Cosmetics Toxicology 18 (3) 277-281 (1980)
 [24 ref. En][Carcinogenesis Div., Cancer Res. Inst.,
 Bombay 400 012, India]

Effects of chewing betel quid, alone or with tobacco, on salivary levels of nitrite and other factors of importance in the formation of nitrosamines were studied. The possible relevance of the findings to the development of oral cancer was assessed. It was found that habitual tobacco chewers did not show nitrite values as high as those in non-chewers. They also failed to show any increase in salivary nitrites after chewing betel quid with or without tobacco. Free amino-N levels in the saliva were not affected significantly by chewing either tobacco or betel quid, while salivary pH was increased by both types of test chew. Thiocyanate levels were significantly higher in habitual tobacco chewers than in non-chewers, and were further increased after the chewing of betel quid with tobacco. VJG

16

Mutagenicity of Chinese wine treated with nitrite.

Lin, J.-Y.; Tai, M.-W.

Food and Cosmetics Toxicology 18 (3) 241-243 (1980)
 [13 ref. En][Inst. of Biochem., Coll of Med., Nat. Taiwan Univ., Taipei, Taiwan]

12 brands of Chinese wine were purchased from the local stores in Taipei city. 7 of the non-distilled wines contained substances that were mutagenic to *Salmonella typhimurium* strains TA 1535 and TA 100 after incubation with nitrite at pH 3. No mutagens were detected in wines made by distillation of fermentation products when treated with nitrite. The free amino acid content of some of the wines was measured. Significant levels of free amino acids were not detected in distilled wines but levels of 3-94 mg/100 ml of various free amino acids were found in the non-distilled wines. The majority of Chinese wine is non-distilled and this, coupled with the over use of sodium nitrite in food processing in China, could be a cause of the high incidence of several types of cancer among Chinese people. VJG

17

Effect of nitrapyrin on nitrapyrin residues and nitrate content in red beet roots fertilized with urea.

Kallio, H.; Linko, R. R.; Tikanmäki, E.; Puntari, I.
Journal of the Science of Food and Agriculture 31 (7) 701-708 (1980) [37 ref. En][Dep. of Chem., Univ. of Turku, SF-20500 Turku 50, Finland]

Effects of application of the nitrification inhibitor nitrapyrin [2-chloro-6-(trichloromethyl)pyridine] to the soil at levels of 0, 2, 6, 18 or 34 kg/ha on nitrapyrin residue concn. in the soil and in red beet grown on the soil, and on nitrate concn. in the red beets, were investigated. Tables and graphs of results are given. After application of nitrapyrin on 8 June, residue concn. in the beets ranged from 0 to 1.19 µg/g on 15 Aug., and from 0 to 0.45 µg/g on 1 Oct. Neither nitrapyrin nor its main breakdown product were detected in canned samples of beets grown on treated soil. Nitrapyrin considerably reduced the nitrate-N concn. in beets, from 0.51 mg/g dry wt for control beets to 0.34 mg/g dry wt. in beets grown in soil treated with 18 kg nitrapyrin/ha. AIDW

18

[The hygienic risk of commercially sterile canned meat.] Zum hygienischen Risiko bei "Fleisch-Dreiviertelkonserven".

Prändl, O.

Archiv für Lebensmittelhygiene 31 (2) 33-35 (1980)
 [7 ref. De, en][Vet. Med. Univ. Wien, Linke
 Bahngasse 11, A-1030 Vienna III, Austria]

The author discusses the proposed classification of commercially sterile canned meat according to Leistner et al. [*Fleischwirtschaft* (1970) 50, 216], which requires an F_s value of 0.65-0.80. As spores of *Clostridium botulinum* may survive at these F_s values, they carry the risk of subsequent germination, proliferation and toxin formation during the proposed 1 yr storage at 15°C. Moreover, the storage temp. is not always maintained. Improving the stability by reducing pH to <4.5 (e.g. acidification of canned aspic sausages) and a_w to <0.95 (e.g. increased fat and salt addition to canned liver sausage) had much more adverse effect on sensory qualities than higher temp. treatment combined with suitable technological conditions. Stability is further reduced by decreasing NO_2^- addition to 70% (1.2-1.4% of nitrite curing salt). Therefore a heat process for canned sausages is recommended which ensures an F_s value of ≥ 2.5 and ensures secure inactivation of *Cl. botulinum* spores. This would allow NO_2^- addition to be limited to the min. required for colour and aroma formation (i.e. 50 p.p.m. NO_2^- or 1% nitrite curing salt). [From En summ.] RM

19

The effect of pH, water activity, sodium nitrite and incubation temperature on growth of bacteria isolated from meats. (In 'Food microbiology and technology'[see FSTA (1981) 13 3B17].) [Lecture]

Roberts, T. A.; Britton, C. R.; Shroff, M. N.
 pp. 57-71 (1979) [19 ref. En, it][Agric. Res. Council,
 Meat Res. Inst, Bristol, UK]

The effect of incubation temp. (1-35°C), NaCl (1, 2 and 4% w/v), pH (5.6 and 6.4) and $NaNO_2$ (50-400 µg/ml, added) on bacterial growth in Brain Heart Infusion broth was studied using *Pseudomonas fragi*, *Enterobacter liquefaciens*, *Lactobacillus* sp. and *Microbacterium thermosphactum* (*Brochothrix thermosphacta*). Data are tabulated in a convenient form for rapid reference, and drawn in three-dimensional figures to illustrate the limits of growth when one factor or more is varied. AS

20

Low-molecular weight sarcoplasm fractions promoting the color formation of cooked cured meat products.

Okayama, T.; Ando, N.; Nagata, Y.

Japanese Journal of Zootechnical Science [Nihon Chikusan Gakkai-ho] 51 (6) 439-442 (1980) [14 ref. En]

[Fac. Agric, Kobe Univ., Kobe-shi 657, Japan]

Studies were conducted on the cured colour formation characteristics of subfraction A of the low-mol. wt. fraction of porcine adductor muscle sarcoplasmic protein. This subfraction was further fractionated by gel chromatography on a 2.5 x 40 cm Sephadex G-15 column in 0.1M NaCl/5mM histidine buffer (pH 7.6). 5 ml fractions were collected. Each was

adjusted to pH 5.5, and made up to 10 ml with m/35 veronal buffer (pH 5.5). Horse heart myoglobin (0.125%) and NaNO_2 (25 p.p.m.) were added, and the mixtures were heated at 75°C for 1 h under a vacuum of 5 mm Hg. Cooked cured pigment content and residual nitrite content of the heated samples were determined, together with the reducing capacity and concn. of SH groups, ninhydrin-positive substances and carbohydrates in the protein fractions. Diagrams of results are given. 5 fractions were isolated; those with Kd values of

0.04–0.48 (region B) and 0.52–0.99 (region C) having high cured colour formation capacity. Both these fractions had high contents of SH groups and reducing substances; both contained ninhydrin-positive substances and carbohydrates (region C having higher carbohydrate concn. than region B). Fe^{2+} was found only in region B. Addition of these fractions to an experimental meat product increased cured colour formation (the region B fraction having a slightly greater effect than the region C fraction); both increased nitrite decomposition. AJDW

21

[Colour of vacuum-packaged Paris ham.]

Goutefongea, R.

Bulletin Technique, Centre de Recherches Zootechniques et Veterinaires de Theix No. 39, 27–31 (1980) [11 ref. Fr] [Sta. de Recherches sur la Viande, CRZV de Theix, 63 110 Beaumont, France]

Studies were conducted on Paris hams, cured with (i) 90 or (ii) 180 p.p.m. NaNO_2 , vacuum packaged at pressures of 5 or 100 Torr, and stored for ≤ 16 days at 10°C either in the dark or under mixed daylight/artificial light illumination. Average residual nitrite concn. in (i) samples was 28.3 p.p.m., vs. 86.7 p.p.m. for (ii). Data are presented for changes in the dominant wavelength and the 'colour difference' value of the meat samples. Both (i) and (ii) samples stored under illumination at 5 Torr pressure showed an initial period of little change in colour (up to 8 days for (ii), 24 h for (i)), after which dominant wavelength gradually decreased and colour difference value gradually increased. Illuminated (i) samples stored at 100 Torr showed initial rapid increase in colour difference value and decrease in dominant wavelength, followed after 3 h by considerably reduced rates of

change of these characteristics. In illuminated (ii) samples held at 100 Torr, dominant wavelength initially decreased sharply, then (after approx. 3 h) increased gradually to almost the initial value at approx. 24 h after packaging, then decreased again gradually; changes in colour difference value showed the opposite pattern of changes. Samples stored in the dark at 5 Torr did not change in colour; changes in the colour of samples stored at 100 Torr were slow. AJDW

• Evaluation of the mutagenicity of sorbic acid - sodium nitrite reaction products produced in bacon-curing brines.

Robach, M. C.; DiFate, V. G.; Adam, K.; Kier, L. D. *Food and Cosmetics Toxicology* 18 (3) 237–240 (1980) [10 ref. En] [Monsanto Co., 800 N. Lindbergh Blvd, St. Louis, Missouri 63166, USA]

Typical bacon-curing brines containing potassium sorbate (2600 p.p.m.), sodium nitrite (40–4000 p.p.m.) and sodium ascorbate (550–55 000 p.p.m.) were reacted under conditions encountered during bacon curing, bacon cooking and brine storage, and in gastric fluid. The reaction solutions and their ether extracts were subjected to Ames Salmonella assays. All solutions and ether extracts and sorbate-nitrite samples produced under bacon-curing conditions were negative in the Salmonella assay, as were the solution simulating the brine and its ether extract and the simulated gastric-fluid sample and its extract. Weak mutagenic activity was detected in the ether extract of the high-temp. sample although the solution itself was negative. Retesting of this sample indicated that the positive response was due to an active compound in the ether used as the extraction solvent. VJG

23

Shelf life of canned vegetables.

Hall, M. N.

Technical Memorandum, Campden Food Preservation Research Association No. 208, 87pp. (1978) [3 ref. En]

Canned fruits and vegetables stored for up to 42 months (since 1974) were analysed at 3 months' intervals for Pb, Sn, Fe and Cr levels. Samples containing added NO_3^- (20 and 100 mg/kg) were included after 1 yr (since 1975). Sensory analysis was carried out on the samples without added NO_3^- . Tables are presented showing all analytical results to date. The results from the samples tested so far indicate that although metal content in some packs could be a limiting factor in shelf life, packs did not become substandard during storage according to the Campden Standards of Quality test, QC6. A mathematical expression was developed which describes the relationships between NO_3^- , time and Sn concn. This was used to predict the effect of various levels of added NO_3^- on the rate of Sn pickup in a number of products. Graphs are included to illustrate this. The study showed that the rate of NO_3^- induced Sn corrosion differs markedly in products with similar pH values, showing that NO_3^- induced detinning is not entirely pH dependent. AS

24

[Changes in nitrite in cured meat products.] [Review] Goutefongea, R.

Viandes et Produits Carnes 1 (4) 6–11 (1980) [77 ref. Fr] [Sta. de Recherches sur la Viande, INRA, Theix - 63110 Beaumont, France]

Aspects considered in this review include: chemical characteristics and reactions of nitrite; nitrosamine formation; analysis of nitrite; free and bound nitrite in meat products; 'disappearance' of nitrite in cured meat

products; the role of nitrite in colour and flavour formation in meat products; oxidant and antioxidant characteristics of nitrite; formation of nitrate from nitrite; and reaction of nitrite with pigments, amino acids, proteins, carbohydrates and adipose tissue. AJDW

25

[Use of NaNO_2 at various doses, in manufacture of Mortadella sausages.] Sobre o emprego do nitrato de sodio, em diferentes dosagens, na preparacao de mortadelas. [Thesis] Moreno, A. G. 103pp. (1979) [42 ref. Pt] Sao Paulo, Brazil; Univ. of Sao Paulo

Comparative studies were conducted on Mortadella sausages made with 1.0, 2.5, 5.0, 10.0 or 15.0 g NaNO_2 /100 kg meat. Residual nitrite, available nitrite, sausage colour and organoleptic properties were evaluated for recently-made samples, and for samples ripened for 1 wk. Tables of results are given. The results show that total and free residual nitrite and nitrosopigment concn. decreased with decreasing initial nitrite concn.; no significant effect of nitrite level on the organoleptic properties (internal appearance, colour, taste, consistency, fattiness, sliceability) of the sausages was observed. The results are discussed in relation to the potential for reduction of the nitrite level used in Mortadella manufacture, and hence reduction of the residual nitrite concn. and the likelihood of nitrosamine formation. AJDW

26

[Determination of the maximum quantity of additives to incorporate in pumping brine.]

Poterre, P.

Viandes et Produits Carnes 1 (6) 30-33 (1980) [Fr] [Charcuterie Exp. du Cent. Tech. de la Salaison, de la Charcuterie & des Conserves de Viande, CNRZ, 78350 Jouy-en-Josas, France]

Problems with detn. of the max. permitted concn. of additives (nitrate, nitrite/ NaCl blend, phosphates, sugar) in curing brines to be injected into hams, etc., are discussed, with reference to legal limits for quantities of these additives in cured meats in France. Effects of the quantity of curing brine injected on the max. additive concn. which may be used in the brine without giving products exceeding the legal limit are discussed. Methods for calculation of the additive concn. which may be used in the curing brine are given, together with tables giving the max. KNO_3 , nitrite/ NaCl blend, phosphate and sugar concn. for brines to be injected at levels of 10-30% of the meat wt. AJDW

27

Why nitrite does not impart color. [Lecture] Dryden, F. D.; Birdsall, J. J.

Proceedings of the Meat Industry Research Conference pp. 119-125 (1980) [19 ref. En] [American Meat Inst., Washington, DC, USA]

The recent tentative conclusion of the FDA that nitrites impart colour to bacon and other cured meat products, and that they must therefore be considered as

colour additives, is critically discussed; it is suggested that, in fact, nitrites fix or stabilize the inherent colour of red meat systems. Evidence to support this view is presented in detail, based on the structure and stability of myoglobin and its oxygenated and nitrite-fixed forms, and the action of various additives, heat treatment, etc. on the colour of fresh and cured meats. [See FSTA (1981) 13 4S498.] AJDW

28

[Effects of nitrite level and curing conditions on colour development and residual amount of nitrite ions in meat products.]

Matsuoka, A.

Journal of Agricultural Science [Tokyo Nogyo Daigaku Nogatu Shuho] 24 (3/4) 256-263 (1980) [17 ref. Ja, en]

Effects of nitrite level and curing under anaerobic and normal conditions on cured meat colour, cooked cured meat colour and its stability, and residual nitrite ions were investigated. Cooked cured meat colour developed at all nitrite levels, but that cured under anaerobic conditions was better than under normal conditions. Stability of cooked, cured meat colour, cured under anaerobic conditions was superior to that cured under normal conditions, and showed a tendency to rise with increasing nitrite level. Recommended nitrite levels in the meat were 0.006-0.01% when the products were not sliced and 0.008-0.03% when sliced. 0.03% residual nitrite in the meat exceeds the amount legally permitted in Japan, when cooked immediately after addition. Residual nitrite in cooked cured meats was 10-20% lower when cured under anaerobic conditions than when cured under normal conditions. It can be concluded that curing the meat under anaerobic conditions improves the stability of the cooked meat colour and reduces the residual nitrite content. [From En summ.] VJG

29

Determination of nitrate and bromide in foodstuffs by high-performance liquid chromatography.

Leuenberger, U.; Gauch, R.; Rieder, K.; Baumgartner, E. *Journal of Chromatography* 202 (3) 461-468 (1980) [20 ref. En] [Kantonales Lab., PO Box CH-3000 Berne 9, Switzerland]

Detn. of nitrate and bromide directly from aqueous extracts by HPLC on an amino phase chemically bonded to a silica gel is described. Compared to other methods, this procedure needs less clean-up, no derivatization, and is faster. Sample treatment for cheese, whey, salads and vegetables, flour and rice are described; tap water, juices and aqueous foods can be injected directly, after filtration. The detection limit varies between 0.05 and 10 p.p.m. depending on the food, e.g. 0.05 p.p.m. nitrate or nitrite in drinking water, 2-5 p.p.m. nitrate in cheese, 5 p.p.m. nitrate in whey. Good agreement was found between the HPLC method and other procedures for detn. of nitrate in salads (which can contain about 2000 p.p.m. nitrate) and tap water. Bromide contents were determined in aqueous extracts of cereals fumigated with methyl bromide; the sensitivity of the method is high enough to monitor the Swiss limit of 50 p.p.m. Br^- . Bromide recovery in raisins, wheat flour, rice and salad spiked with 50 p.p.m. was 80-90%. AL

30

Mechanism of nitrite-induced germination of *Clostridium perfringens* spores.

Ando, Y.

Journal of Applied Bacteriology 49 (3) 527-535 (1980)
[21 ref. En][Hokkaido Inst. of Public Health,
Sapporo 060, Japan]

31

Nitrite-reacting substances in Japanese radish juice and their inhibition of nitrosamine formation [under gastric conditions].

Kurechi, T.; Kikugawa, K.; Fukuda, S.

Journal of Agricultural and Food Chemistry 28 (6)
1265-1269 (1980) [27 ref. En][Dep. of Vet. Physiol. &
Pharmacology, Texas A&M Univ., College Station,
Texas 77843, USA]

32

[Comparison of methods for determination of nitrate in milk products.] Ein Vergleich der Nitratbestimmungsmethoden in Milchprodukten. [Booklet]

Kreisner, M.; Fink, J.

36pp. (1978) [12 ref. De] Frankfurt am Main, Federal Republic of Germany; Deutsche Landwirtschafts-Gesellschaft

4 spectrophotometric methods for estimating nitrate in whole milk are compared. The methods of Kay & Mrowetz [*Milchwissenschaft* (1960) 15 (11) 550] and of Liebenow [Thesis, Berlin, 1969], using 2,4-dimethylphenol, have lower limits of detection of 0.25 and 10 mg/kg resp., with s.d. of $\pm 5\%$; the upper limit for the method of Kay & Mrowetz is approx. 150 mg/kg. The method of Brathen & Svensen [FSTA (1973) 5 11P1685] using indole can detect 0.6 mg NO_3/kg with max. variation of 10% between determinations. The method of Greweling et al. [*Journal of Agricultural Food Chemistry* (1964) 12 (2) 139] has a lower limit of 1 mg/kg and an upper limit of 26.25 mg/kg. The method of Kay & Mrowetz is preferred for serial analysis of nitrate in milk samples on account of its wide range and reproducibility. BWH

33

Reaction between nitrite and low salt-soluble diffusible fraction of meat. Some compounds influencing nitrite depletion and producing unidentified-N compounds.

Miwa, M.; Okitani, A.; Kato, H.; Fujimaki, M.; Matsuura, S.

Agricultural and Biological Chemistry 44 (9) 2179-2183 (1980) [18 ref. En][Nat. Food Res. Inst., Min. of Agric., Forestry & Fisheries, Tsukuba, Ibaraki 305, Japan]

A low salt-soluble, diffusible fraction of meat was separated into basic, neutral and acidic fractions.

Investigations were then conducted on the reaction of each fraction with nitrite and on the recovery of the added nitrite. The basic fraction showed the lowest ability to decompose nitrite and had 88% recovery of added nitrite-N. Hypoxanthine was one of the main components that affected the recovery in the basic fraction. In the neutral fraction, 42% of nitrite was decomposed, and the recovery of the nitrite was 107%. In the acidic fraction, >80% of nitrite was decomposed and 30% was converted to unidentified-N compounds. Among endogenous acidic substances tested, cysteine acid showed the highest ability to decompose nitrite, with formation of unidentified-N compounds. AS

34

Reactions of nitrite in meat. [Lecture]

Ito, T.; Cassens, R. G.; Greaser, M. L.

Proceedings of the European Meeting of Meat Research Workers No. 25, 8.5:727-8.5:732 (1979) [18 ref. En, de, fr, ru][Muscle Biol. Lab., Univ. of Wisconsin, Madison, Wisconsin, USA]

When nitrite is added to meat, it may react with many of the constituents, and the environment of the meat including such factors as concn. of reactants, pH and temp. influences the reactions. Obvious interest has centered on the reaction of nitrite with the proteins of meat not only because numerous potential reaction sites are present but also because experimental studies with labelled nitrite have shown that a large proportion (20-50%) of the label added is recoverable from the meat proteins. The reaction of nitrite with tryptophyl residues of protein was investigated; it is well known that tryptophan is easily nitrosated, given appropriate conditions of pH and concn. On the basis of spectrophotometric data, it was found to be difficult to nitrosate tryptophyl residues of myosin even when the myosin was denaturated and the reaction was conducted at low pH (3.0). Lysozyme, which is soluble at low pH and high in tryptophan, nitrosated rather easily. Additional work with model systems showed that nitrosated protein could transnitrosate a receptor molecule such as myoglobin. [See FSTA (1981) 13 5S668.] STI

35

Effect of additives and ripening parameters on growth and toxin production of *Clostridium botulinum*. [Lecture]

Incze, K.; Delenyi, M.

Proceedings of the European Meeting of Meat Research Workers No. 25, 12.1:877-12.1:882 (1979) [10 ref. En, de, fr, ru][Hungarian Meat Res. Inst., Budapest, Hungary.]

Batches of raw sausage were made with 600 p.p.m. KNO_3 , 150 p.p.m. NaNO_2 , or no nitrite or nitrate. Each sausage was injected with 10^3 spores of *Clostridium botulinum*, either at the centre or the end. Samples were taken at weekly intervals during ripening, and phosphate buffer extracts were tested for toxin by intraperitoneal injection into mice. The results showed toxin formation during the early period of ripening in

the samples made with neither nitrate or nitrite, but not in those containing either curing agent. After several wk of ripening, toxin formation ceased and the toxin already formed was inactivated. Similar inactivation of toxin was observed when sausages were injected with preformed toxin rather than *Cl. botulinum* spores. The mechanism of inactivation of *Cl. botulinum* toxin is under investigation. [See FSTA (1981) 13 5S668.] STI

36

The use of irradiation to reduce or eliminate nitrite in cured meats. [Lecture]

Wierbicki, E.; Brynjelfsson, A.

Proceedings of the European Meeting of Meat Research Workers No. 25, 8.2:719-8.2:720 (1979) [En, de, fr, ru] [Radiation Preservation of Food Div., Food Eng. Lab., US Army Natick R&D Command, Natick, Massachusetts 01760, USA]

Irradiation allows reduction or elimination of nitrite in cured meats. Experiments have shown that added NaNO_2 in ham could be reduced from 156 to 25 mg/kg, and in corned beef to 50 mg/kg. 25 mg/kg NaNO_2 is needed to prevent the colour fading in ham after irradiation. However, corned beef without NaNO_2 was of good overall quality. Addition of nitrite to bacon, preserved by irradiation, could be reduced from the present level of 120 to 20 mg/kg. All the quality characteristics, before and after frying, were similar to the nonirradiated, fully cured bacon. Experiments have shown that nitrite addition can be entirely eliminated from bacon preserved by irradiation. The resulting products had the normal colour of raw bacon, the spoilage microorganisms were destroyed, there was no residual nitrite and no nitrosamines. The estimated cost of the process is < 1 cent/lb for low dose irradiated bacon for distribution under refrigeration, and ≤ 3 cents/lb for bacon in hermetically sealed packages, and treated with a sterilizing dose for distribution without refrigeration. [See FSTA (1981) 13 5S668.] STI

37

The effect of potassium sorbate and sodium nitrite on the organoleptic properties, stability, and growth of *Bacillus cereus* and *Clostridium perfringens* in cooked sausage. [Lecture]

Petäjä, E.; Raevuori, M.; Puolanne, E.; Hill, P.

Proceedings of the European Meeting of Meat Research Workers No. 25, 12.9:917-12.9:923 (1979) [En, de, fr, ru] [Inst. of Meat Tech., Univ. of Helsinki, Helsinki, Finland]

Effects of potassium sorbate (PS) concn. of 0, 1000 and 2500 mg/kg, and NaNO_2 concn. of 0, 40, 80 and 150 mg/kg, together with combinations of these, on the flavour, colour and stability of cooked sausages, as well as on the growth of *B. cereus* and *C. perfringens* in the sausage were studied. The flavour of sausages with 2500 mg/kg PS differed highly significantly from that of sausages containing 0 and 1000 mg/kg for all nitrite concn. PS imparted an unpleasant flavour. With NaNO_2 concn. of 0 and 40 mg/kg there was no significant difference in flavour between PS concn. of 0 and 1000 mg/kg, but with 80 mg/kg of NaNO_2 the difference in PS flavour was significant. NaNO_2 caused a highly

significant improvement in flavour for PS levels of 0 and 1000 mg/kg. PS had no effect on the colour of the sausage. In cold storage (+7°C) none of the treatments studied had any significant effect on the total aerobic bacterial count. When the sausage was inoculated with *B. cereus* and *C. perfringens* (approx. 100 spores of each/g), NaNO_2 had a more pronounced inhibiting effect than PS on the total aerobic bacterial count at 15°C, the counts of these bacteria being lowest in samples containing ≥ 80 mg/kg NaNO_2 . When the sausages were stored at +25°C, PS appeared to restrict growth of total aerobic bacteria more effectively than NaNO_2 , the inhibition being most pronounced in combinations containing 2500 mg/kg PS. A PS concn. of 1000 mg/kg also appeared to restrict the growth of total aerobic bacteria. The growth of *B. cereus* and *C. perfringens* was considerably inhibited by 150 mg/kg of NaNO_2 . [See FSTA (1981) 13 5S668.] STI

38

Use of reduced amounts of nitrite in the production of Italian typical salami.

Baldini, P.; Farina, G.; Palmia, F.; Parolari, G.; Raczynsky, R.

Proceedings of the European Meeting of Meat Research Workers No. 25, 12.3:883-12.3:890 (1979) [En, de, fr, ru] [Sta. Sperimentale per l'Ind. delle Conserve Alimentari, Parma, Italy]

A technique was studied for manufacture of Italian salami, which allows reduction of the amount of nitrite used to prevent growth of clostridia and enterobacteria. Inhibiting factors other than nitrite are used, thus avoiding the formation of nitroso compounds. Slightly dehydrating the meat at refrigeration temp. and keeping the comminuted meat or raw sausages for a few days at a temp. of 0 to -4°C results in inactivation of clostridia, in the presence of only 50 p.p.m. nitrite. Addition of small amounts of acetic acid, which does not modify the pH of the product, causes a reduction in the number of enterobacteria in salami containing low quantity of chloride (2.5%) and fat (20-23%); this fact is enhanced at low holding temp. (4°C) and low pH (5.5). During drying and ripening the acetic acid prevents, sometimes only partially, the multiplication of enterobacteria in salami in which sugar has not been used to lower pH; multiplication of clostridia has never been noted (max. 9/g). At drying and ripening temp. <20°C, no increase in the number of pathogenic staphylococci inoculated into the product at the level of 10^4 /g is observed. [See FSTA (1981) 13 5S668.] STI

39

Nitrite sources and nitrosamine formation *in vitro* and *in vivo*.

Walters, C. L.; Carr, F. P. A.; Dyke, C. S.; Saxby, M. J.; Smith, P. L. R.

Food and Cosmetics Toxicology 17 (5) 473-479 (1979) [29 ref. En] [British Food Manufacturing Ind. Res. Ass., Randalls Rd., Leatherhead, Surrey, UK]

Consumption of salad-type meals rich in nitrate (90-115 mg) by normal adults, was followed by a rapid rise in salivary nitrite levels, and then by a fall towards the fasting nitrite levels. Nitrite level and pH of gastric

contents increased markedly following consumption of a meal containing nitrate, reaching max. within about 45 min, then returning towards fasting levels. Studies were made in vitro and in vivo, using foods as sources of nitrosatable amines, on the formation of *N*-nitroso compounds under the conditions encountered in the human stomach, with special reference to the different thiocyanate concn. in smokers and non-smokers. Major volatile nitrosamines produced when foods were incubated with nitrite under acid conditions in vitro were *N*-nitrosopiperidine (NPiP) and *N*-nitrosopyrrolidine. At nitrite concn. likely to occur in the stomach, nitrosamine formation was reduced and was significantly lower in the absence of thiocyanate than in its presence at levels of 0.2–3mm. Trace amounts of NPiP were detected occasionally in the gastric contents of volunteers after ingestion of homogenized foods containing nitrite. VJG

40

[Evaluation of nitrate in drinking water in relation to health hazards.] *Gesundheitliche Beurteilung des Nitrats im Trinkwasser.*

Selenka, F.

Zentralblatt für Bakteriologie, 1B 172 (1/3) 44–58 (1980) [39 ref. De, en] [Inst. für Hygiene, Ruhr-Univ., D-4630 Bochum, Federal Republic of Germany]

Nitrate in drinking water is discussed with reference to: nitrate in ground water; effects of N fertilizer application to the soil on nitrate concn. in ground and river water; nitrate in vegetables; the relative significance of water and various foods as sources of nitrate in the total diet; absorption of nitrate in the alimentary tract; toxicity of nitrate; metabolism of nitrate to nitrite; methaemoglobinaemia caused by nitrite; and nitrosamine formation in foods or in the alimentary tract. AJDW

41

[Nitrate contents in some citrus juices.] [Lecture]

Mammi' de Leo, M.; Mazza, B.; Giacomo, A. di

Essenze Derivati Agrumari 48 (4) 399–408 (1978)

[8 ref. It] [Sta. Sperimentale per l'Ind. delle Essenze e dei Derivati Agrumari, Reggio Calabria, Italy]

23 samples of industrial orange juice (Biondo Comune, from Piana di Rosarno), 17 of laboratory-pressed grapefruit juice (from Calabria and Basilicata) and 65 of laboratory-pressed clementine juice (from Calabria and Basilicata) were analysed for sp. gr., refractive index, concn., soluble solids, acidity, 'ratio' (corrected soluble solids:acidity), nitrate (mg N_2O_5 /kg in conc. juices, /l in natural juices), and ash. Full results are tabulated. N_2O_5 values (mg/l) were 0.726–2.547 (mean 1.421), 1.100–2.900 (1.980) and 0.229–0.549 (0.325), resp. Values are higher than those previously observed; they can be considered as normal values. [See FSTA (1981) 13 6J839.] RM

42

The stability of nitrate in unpreserved potable water samples.

Delfino, J. J.

Journal American Water Works Association 71 (10)

584–586 (1979) [6 ref. En] [State Lab. of Hygiene, Univ. of Wisconsin, Madison, Wisconsin, USA]

The need for preserving potable water samples, prior to testing for nitrate, by lowering the pH to <2 using H_2SO_4 is examined. 3 studies were done using the Cd reduction/diazotization colorimetric method to analyse NO_3^- in potable tap and impure well water. All studies confirmed that NO_3^- is stable in potable water samples for at least 2 wk without acid preservation; if unusually high contamination is suspected samples should be kept at 4°C to maintain NO_3^- concn. Thus the regulatory need for this use of acid in the USA is called into doubt. LH

43

[Possibilities of reducing nitrate contents of vegetables by selection methods.]

Zhuchenko, A. A.; Andryushchenko, A. K.

Vestnik Sel'skokhozyaistvennoi Nauki, Moscow,

USSR No. 12, 62–71 (1980) [32 ref. Ru, en] [Moldavskii Nauchno-issled. Inst. Oroschaemogo Zemledeliya & Ovoschevodstva, USSR]

During 1976–1979, cv. of numerous vegetables were grown in chernozem experimental plots (5 m²) containing 10–30 mg nitrate N/kg dry soil, and effects of different levels of fertilization with N and P on NO_3^- contents of the vegetables were studied. Overall ranges (mg/kg DM) in edible parts of 24 var. of vegetables found by the authors are tabulated in comparison with literature data. Mean values for nitrate contents (mg/kg DM) are tabulated for the following vegetables grown at fertilization levels of N_0P_{180} , $N_{180}P_{180}$ and $N_{360}P_{180}$: 15 cv. of radish, 6 cv. of tomato (each at red, orange and green stages), 3 cv. of spring onion at 2 different harvest dates, 8 cv. of carrot at 2 stages of ripeness, 26 cv. and hybrids of cucumber and 12 cv. of hot-house cucumber, 1 cv. of beetroot, 3 cv. of sweet pepper, 1 cv. of lettuce, 1 cv. of bean, and 3 cv. of aubergine. It is concluded that differences in nitrate content between different cv. of a given vegetable grown under uniform conditions of N fertilization may amount to 200–500%; that nitrate accumulation is also dependent on N supply in soil; and that a marked reduction in the average nitrate content of commercial vegetable crops may be achieved by growing of the cv. showing the least nitrate accumulation. SKK

44

Nitric-oxide myoglobin as an inhibitor of lipid oxidation.

Kanner, J.; Ben-Gera, I.; Berman, S.

Lipids 15 (11) 944–948 (1980) [44 ref. En] [Inst. for Tech. & Storage of Agric. Products, Volcani Cent., PO Box 6, Bet Dagan 50–100, Israel]

In order to understand the stabilizing effect of nitrite on the lipid fraction in meat products, as well as its mechanism, the effect of nitric-oxide myoglobin (MbNO) on lipid oxidation was studied in linoleate and β -carotene-linoleate aqueous model systems and compared with that of metmyoglobin (MMb) and oxy-myoglobin (MbO₂) in short- and long-term reactions. While MMb and MbO₂ had a clear prooxidative effect, MbNO₂ under the same conditions, acted as an antioxidant. The specific antioxidative

activity of MbNO was maintained even in the presence of prooxidants such as haemproteins. The significance of the conversion of MbO₂ and MMB into an antioxidant during the meat curing process is discussed. AS

45

[Quality of veal and young bull meat. I. Animal material, colour brightness and pH.] Untersuchungen über die Beschaffenheit von Kalb- und Jungbullenfleisch. I. Tiermaterial, Farbhelligkeit und pH-Wert.

Freudenreich, P.; Schön, L.; Scheper, J.

Fleischwirtschaft 60 (9) 1721-1725 (1980) [17 ref. De, en] [Bundesanstalt für Fleischforschung, 8650 Kulmbach, Federal Republic of Germany]

In view of the trend to produce heavier calves (> 200 kg live wt.), objective criteria of veal characteristics and their relation to slaughter wt. were investigated. 225 calves and 35 head of beef of 6 wt. grades (109-427 kg live wt.) were examined for meat colour (Göfo value) and pH. Effects of wt., sex, breed, commercial grade, degree of fatness and meat cut were evaluated by statistical analysis. Results, shown graphically and in tables, revealed that meat colour alone was an inadequate criterion of veal characteristics, as its relation to important physical and sensory meat properties was very loose, and its values fluctuated widely (coeff. of variation 27%). No useful information could be gained from pH detn. RM

46

Update: nitrite-free meat products. (In 'Proceedings of the 32nd Annual Reciprocal Meat Conference'[see

FSTA (1981) 13 6S964.]) [Lecture]

Braathen, O.

pp. 143-149 (1979) [En] [Norwegian Meat Res. Lab., Lorenveien 37 - Postboks 96, Refstad, Oslo 5, Norway]

Aspects considered include: legislation restricting use of nitrite and nitrate in meat products in Norway; current use of nitrite in the Norwegian food industry; illegal measures used to give a pink appearance to sausages in which nitrite is prohibited; consumer acceptance of nitrite-free sausages; the shelf-life of nitrite-free products; sausage types and other meat products traditionally free from nitrite; declaration of added nitrite; the potential health hazard from nitrite-free cured meat products; and the legal situation in relation to nitrite and nitrate in meat products in other European countries (Sweden, France, the Netherlands, Denmark, Finland, Hungary, the Federal Republic of Germany). AJDW

47

[Added nitrate and nitrite levels in brine curing.]

Nitrat- und Nitritdosierung bei der Nasspökung.

Prändl, O.

Fleischwirtschaft 60 (10) 1798, 1801-1804 (1980) [4 ref. De] [Inst. für Fleischhygiene, Fleischtech. & Lebensmittelkunde, Veterinärmed. Univ. Wien, Linke Bahngasse 11, A-1030 Vienna-III, Austria]

The effects of meat curing with nitrate or with nitrite

curing salt (NPS) on nitrite levels in brine-cured meat are discussed with reference to literature data.

Calculations show that brine-curing with NPS at high brine concn. may result in much higher nitrite levels in the product than curing with nitrate. Apart from brine and NPS concn., the nitrite concn. in the meat is dependent on its fat concn. Guidelines are proposed for limiting NPS and nitrate additions to brine in relation to the fat content and meat:brine ratio; tables show the recommended NPS in brine (kg NPS/100 l) and nitrate concn. in brine (g/100 l) to ensure 0.06% KNO₃ or 0.05% NaNO₃ in fat-free meat at meat:brine ratio 1:1, 2:1 and 3:1, fat contents 0-70%. RM

48

Nitrites in bacon; proposed exception from the color additive definition and request for information on other meat products that may qualify for the exception to the color additive definition.

United States of America, Food & Drug Administration

Federal Register 45 (227, Nov. 21) 77043-77047 (1980) [En] [Washington, DC, USA]

The FDA concludes that nitrites in bacon are not colour additives under the Federal Food, Drug, and Cosmetic Act because nitrites do not impart colour to bacon within the meaning of the statutory definition of colour additives. The true colour-imparting pigment in meat is myoglobin. Nitrites merely fix the pigment in a form that produces a stable, red colour. CAS

49

[Polarographic determination of nitrates in meat products and other foods.]

Branca, P.; Ricottilli, F.; Spagnolini, G. P.

Bollettino dei Chimici dei Laboratori Provinciali 6 (S3) 285-295 (1980) [23 ref. It] [Lab. Chimico Provinciale di Torino, Via S. Domenico 22/8, 10122 Turin, Italy]

The quantitative detn. of NO₃⁻ in food products by fast polarography using direct current and differential pulse (see FSTA (1981) 13 2A58) is described. Tabulated results from 6 meat products showed 93-106% recoveries of 20-300 p.p.m. added NO₃⁻; 94-107% recoveries were recorded for 4.4-53.1 p.p.m. NO₃⁻ added to 6 samples of red and white wine, with mean absolute error 1.94 and 3.11% resp., coeff. of variation 2.80 and 3.65% resp. Possible application to detn. of NO₂⁻ is under investigation. RM

50

Effect of pre-harvest spray of calcium nitrate of the storage behaviour of grape cv. Perlette.

Gupta, O. P.; Jindal, P. C.; Singh, B. P.

Haryana Agricultural University Journal of Research 10 (2) 204-206 (1980) [5 ref. En] [Dep. of Hort., Haryana Agric. Univ., Hissar, India]

Perlette grape vines sprayed with 0, 0.25, 0.5, 0.75 and 1.0% Ca(NO₃)₂, 10 days before harvest were kept at 34 ± 4°C and 65% RH for 3 days after harvest and analysed for wt. loss, total soluble solids (TSS), acidity, organoleptic rating and ratio of healthy : spoiled berries (H:S). Increasing concn. of Ca(NO₃)₂ reduced % wt. loss and decay of stored grapes, giving an H:S ratio of 0.156

in control grapes vs. 5.044 in grapes sprayed with 1.0% $\text{Ca}(\text{NO}_3)_2$. Spraying improved initial TSS levels from 12.5% to a max. of 16.0% in the 0.75% sprayed grapes. Initial acidity was also increased from 0.45% to a max. of 0.54% in the 0.75% sprayed vines. Spraying generally increased organoleptic ratings, more notably after storage, from 5.8 to 7.9. LH

51

[Nitrate and nitrite contents of carrots.]

Lemieszek-Chodorowska, K.

Roczniki Państwowego Zakładu Higieny 30 (6) 567-570 (1979) [15 ref. Pl, ru, en] [Zakładu Badania Żywności i Przedmiotów Użytku Państwowego Zakładu Higieny, Warsaw, Poland]

Contents of (i) nitrites (694 samples) and nitrates (835 samples) were determined in carrots during the period Oct. 1977-May 1978. Levels were divided into various categories viz. 0, ≤ 1 , $> 1-5$, $> 5-10$ and > 10 mg NaNO_2 /kg for (i) and ≤ 50 , $> 50-250$, $> 250-2000$, $> 2000-4000$, $> 4000-6000$ and > 6000 mg KNO_3 /kg for (ii). For (i), 12 samples (1.7%) were in the highest category, the max. concn. found being 40 mg/kg; for (ii) 2 samples (0.2%) were in the highest category, the max. concn. being 7000 mg/kg. As the max. levels of both (i) and (ii) are potentially dangerous to infants, need for careful analysis of carrots intended for infant foods is emphasized. In view of the findings, max. concn. of 1 and 250 mg are proposed for (i) and (ii) resp. in fresh carrots intended for use in baby foods. HBr

52

[Occurrence of nitrosamines in silage and in bovine rumen contents and milk.] Zum Vorkommen von Nitrosaminen in Silage sowie Panseninhalt und Milch von Rindern. [Thesis]

Heerdegen, C.

62pp. (1979) [73 ref. De, en] Munich, Federal Republic of Germany; Fachbereich Tiermedizin, Ludwig-Maximilians-Universität [Inst. für Hygiene & Tech. der Lebensmittel Tierischen Ursprungs, Munich, Federal Republic of Germany]

Nitrate and nitrite contents of 17 milk samples ranged from 0.2 to 5.6 and 0 to 0.4 p.p.m., resp. During storage for 3-5 days at 6°C, the nitrite content of milk tended to increase, and increases were also found when milk was heated (especially at 120°C). Nitrosamines were not detected in silage or in any of the raw or heated milk samples. MEG

53

Determination of nitrite in human, cow and market milks by gas-liquid chromatography with electron-capture detection.

Tanaka, A.; Nose, N.; Yamada, F.; Saito, S.; Watanabe, A.

Journal of Chromatography 206 (3) 531-540 (1981) [12 ref. En] [Saitama Inst. of Public Health, Kamiokubo-Higashi, 639-1, Urawa, Saitama, Japan]

A simple and practical method for detn. of very small amounts of nitrite in human, cow and market milks is described. It is based on the reaction of nitrite with 1-hydrazinophthalazine in acidic solution to form

tetrazolophthalazine, a stable compound which can be extracted with an organic solvent and then determined by GLC with electron-capture detection using a column of 3% OV-225 on Chromosorb W HP; the detection limit for nitrite was 2 ng/ml. The procedure for determining nitrite in milks involves extraction with solvent, followed by further clean-up by alumina column chromatography; the detection limit is about 4 parts/ 10^9 and recovery in human, cow and market milks was satisfactory. The method makes possible a micro-assay for nitrite. The tetrazolophthalazine was identified by its elemental composition, m. p. and by combined gas chromatography-MS. AS

54

Why nitrite does not impart color.

Dryden, F. D.; Birdsall, J. J.

Food Technology 34 (7) 29-42 (1980) [23 ref. En] [American Meat Inst., PO Box 3556, Washington, DC 20007, USA]

It is proposed that nitrite fixes inherent colour of red meat, rather than actually providing it. This proposal is based on the fact that nitrite forms nitric oxide in the presence of reducing agents, which then forms nitrosylmyoglobin to stabilize the pigment in a similar way to O_2 in the live animal. The complex thus formed is very much more stable than oxymyoglobin because of the unpaired electron on the N atom. Excess nitrite added beyond that needed to fix pigment does not increase colour intensity. LH

55

[Is nitrite desirable in cured meat products?]

[Review]

Roon, P. S. van

Tijdschrift voor Diergeneeskunde 105 (22) 951-958 (1980) [39 ref. Nl, en] [Fac. Diergeneeskunde, Utrecht, Netherlands]

56

Biochemical basis for nitrite-inhibition of *Clostridium botulinum* in cured meat. [Review]

Benedict, R. C.

Journal of Food Protection 43 (11) 877-891 (1980) [164 ref. En] [E. Reg. Res. Cent., USDA, Philadelphia, Pennsylvania 19118, USA]

A review is presented of the biochemistry of *C. botulinum* (including growth requirements, synthesis of metalloproteins, sporulation and outgrowth), of chemistry of meat curing (contents of selected reactants in meat, possible reactions of nitrite), and of mechanisms for inhibition of clostridial growth by

nitrite. Suggested inhibitory mechanisms include oxidation of cellular biochemicals, restriction of metal utilization, and alteration of cell membrane function. DIH

57

[Nitrosation of pigments in sausages.]

D'Aubert, S.; Calcinardi, C.

Archivio Veterinario Italiano 31 (1/2) 3-4 (1980) [2 ref. It, en] [Istituto di Ispezione degli Alimenti di Origine

Anim., Univ. degli Studi di Milano, Milan, Italy]

Studies were conducted on the pH and the % nitrosation of haem pigments in 21 samples of commercial sausages, 13 made with nitrite, 8 made without nitrite. No nitrosopigments were detected in the samples made without nitrite. % nitrosation of haem pigments in sausages made with nitrite ranged from 40 to 82.5%; there was a tendency for low pH to be associated with high % nitrosation. Model studies on sausage emulsions containing 150 p.p.m. nitrite and adjusted to various pH values showed the % nitrosation of haem pigments to be 5.8 at pH 6.7, 34.2 at pH 6, and 70 at pH 5. AJDW

58

[Variations in the concentration of N-nitroso compounds in meat products processed with minimal amounts of nitrite.] Schwankungen in der Konzentration von N-Nitroso-Verbindungen in Fleischzeugnissen, die mit minimalen Mengen an Nitrit hergestellt werden.

Preda, N.; Popa, L.

Fleischwirtschaft 60 (12) 2184-2186; 2211-2212 (1980) [16 ref. De, En] [Inst. of Med. & Pharmacy, Str. 1 Mai ur. 13, Cluj-Napoca, Romania]

6-yr studies on nitrite and nitrosamine levels in a variety of meat products produced the following results: fresh products, e.g. Pariser, Prague sausages, Prague ham etc., processed with NaNO_2 , contained NO_2^- residues of 5-7 p.p.m. Smoked products, e.g. high-quality salamis, had NO_2^- residues of 4-6 p.p.m. Dried matured salamis of Sibiu type, which are processed with NaNO_3 , had 4 p.p.m. NO_2^- in 12.9% of samples, < 3 p.p.m. in the rest, and no nitrosamines; in fresh products, 18.75% of samples contained nitrosamines (at ≤ 3 parts/billion). The results lend support to the Romanian legislation limiting NO_2^- residues to 7 p.p.m. No cases of botulism were reported after consumption of meat products made with these low NO_3^- or NO_2^- additions. RM

59

[Nitrites and nitrates in Polish meat products.]

Lemieszek-Chodorowska, K.

Roczniki Panstwowego Zakladu Higieny 31 (1) 49-51 (1980) [8 ref. Pl, ru, en] [Zakladu Badania Zywnosci i Przedmiotow Uzytku Panstwowego Zakladu Higieny, Warsaw, Poland]

Contents of NaNO_2 in 2109 samples of 6 different types of Polish meat products (sausages, bacon, cured meats, various canned preserves) are tabulated. The levels are broken down into 5 different categories, viz. ≤ 50 , $> 50-100$, $> 100-150$, $> 150-200$ and > 200 mg/kg; 200 mg/kg is the official limit. % distribution of the samples into these 5 categories was 64.4, 24.6, 5.7, 3.2 and 2.1, resp. Similar figures are quoted for contents of KNO_3 in 2115 samples of the same types of meat product; % distribution is also into 5 categories, viz. ≤ 300 , $> 300-500$, $> 500-1000$, $> 1000-2000$ and > 2000 mg/kg; 2000 mg/kg is the official limit. % distribution was 67.7, 12.5, 13.8, 5.6 and 0.4, resp. It is accordingly recommended that official limits be reduced, as follows: canned meat products, nitrites 50

and nitrates 500 mg/kg; other cured meats, nitrites 150 and nitrates 1000 mg/kg. Ultimate withdrawal of both groups of compounds is advocated. HBr

60

Processing factors that influence the sensory quality of braunschweiger.

Chyr, C.-Y.; Sebranek, J. G.; Walker, H. W.

Journal of Food Science 45 (5) 1136-1138 (1980) [12 ref. En] [Dep. of Food Tech. & Anim. Sci., Iowa State Univ., Ames, Iowa 50011, USA]

Liver pretreatment, nitrite level, cooking temp., addition of calcium-reduced dried skim milk (CRDSM) and fat content were investigated for their effects on the sensory quality of braunschweiger. Liver pretreatment, such as scalding at 93°C for 2 min, soaking in brine at 0°C for 1 h or freezing, had a significant effect on colour but not on the overall acceptability of the product. Braunschweiger made with or without nitrite showed a difference in colour but not in flavour. Cooking temp. affected texture, flavour, overall acceptability, spreadability, product stability, and colour of the finished product. Addition of 3.5% CRDSM enhanced the flavour and improved the stability of liver sausage cooked at high temp. Braunschweiger containing 20, 30, and 35% fat showed not significant differences in overall acceptability. High fat content in the product favoured creamy texture and improved sliceability but resulted in a light pink colour. IFT

61

[Nitrate and nitrite in gelatin, stock cubes, and similar products.]

Cantoni, C.; D'Aubert, S.; Renon, P.

Archivio Veterinario Italiano 30 (3/4) 142 (1979) [9 ref. It, en] [Istituto di Ispezione degli Alimenti di Origine Anim., Univ. degli Studi di Milano, Milan, Italy]

Nitrates and nitrites were determined in (i) 6 samples of edible gelatin, (ii) 6 samples of stock preparations for meat products, and (iii) 10 samples of soup in cubes. Ranges of values for nitrite concn. were (p.p.m.): (i) 37.4-265.8, (ii) 30.43-165.37, and (iii) 0-278. Corresponding ranges of values for nitrate concn. (p.p.m.) were: (i) 424.3-6608, (ii) 203.9-699.46, and (iii) 98-493. AJDW

62

Nitrogen assimilation by *Salmonella typhimurium* in a chemically defined minimal medium containing nitrate, nitrite or ammonia.

Page, G. V.; Solberg, M.

Journal of Food Science 45 (1) 75-76, 83 (1980) [11 ref. En] [Dep. of Food, Rutgers - State Univ., Cook Coll., New Brunswick, New Jersey 08903, USA]

In a chemically defined minimal medium, *S. typhimurium* was capable of utilizing nitrate, nitrite, and NH_3 as sole N sources, but was unable to utilize hydroxylamine. The generation times calculated for *S. typhimurium* during anaerobic growth with either nitrite or NH_3 as the N source were not statistically different indicating that these 2 N compounds were assimilated at comparable rates. Faster generation times were observed when nitrate was provided as the

sole N source while the fastest generation times were observed in anaerobic cultures containing both nitrate and NH_3 . *S. typhimurium* utilized NaNO_2 as the sole N source at concn. as high as 400 $\mu\text{g/ml}$ (5.6mM) but NaNO_2 concn. of $\geq 500 \mu\text{g/ml}$ (7.0mM) resulted in complete inhibition. IFT

63

Effects of various concentrations of sodium nitrite and potassium sorbate on nitrosamine formation in commercially prepared bacon.

Robach, M. C.; Owens, J. L.; Paquette, M. W.; Sofos, J. N.; Busta, F. F.

Journal of Food Science 45 (5) 1280-1284 (1980) [15 ref. En] [Monsanto Co., 800 N. Lindbergh Boulevard, St. Louis, Missouri 63166, USA]

Pork bellies (270) were processed under regular commercial conditions using various concn. (5 treatments) of sodium nitrite and potassium sorbate. The bacon produced was stored at 3°C, then fried and tested for nitrosamines by gas chromatography-thermal energy analysis at 0 and 21 days after slicing. Nitrite and sorbate concn. were determined weekly during a 49-day period of 3°C storage. Bacon processed without sodium nitrite, regardless of sorbate concn. contained low (<4.4 parts/billion) levels of *N*-nitrosopyrrolidine (NPYR) after being fried at 171°C for 3 min on each side. Bacon processed with 40 p.p.m. nitrite and 0.26% potassium sorbate contained an average of 8.7 parts/billion NPYR at zero time slicing) and 5.4 parts/billion after 21 days of 3°C storage under vacuum packaged conditions. Bacon with 80 parts/billion nitrite and 0.26% potassium sorbate had average NPYR levels of 14.3 parts/billion at zero time and 11.4 parts/billion after 21 days of refrigerated storage. Bacon made with 120 parts/billion nitrite contained an average of 28.1 parts/billion NPYR at zero time and 16.2 parts/billion after 21 days at 3°C. After frying the bacon, 61-71% of the potassium sorbate remained in the product. Methods for nitrosamine analysis and sorbate detn. are described. IFT

64

Effects of various concentrations of sodium nitrite and potassium sorbate on *Clostridium botulinum* toxin production in commercially prepared bacon.

Sofos, J. N.; Busta, F. F.; Bhothipaksa, K.; Allen, C. E.; Robach, M. C.; Paquette, M. W.

Journal of Food Science 45 (5) 1285-1292 (1980) [32 ref. En] [Dep. of Food Sci. & Nutr., Univ. of Minnesota, St. Paul, Minnesota 55108, USA]

The study consisted of 5 treatments including formulations with or without sodium nitrite (120 p.p.m.) or potassium sorbate (0.26%) or both nitrite (40, 80 p.p.m.) and sorbate (0.26%). Packages (300 per treatment) of commercially prepared bacon were inoculated with *Clostridium botulinum* spores from 10 strains (5 type A and 5 type B) and temp. abused at 27°C. Uninoculated packages (100 per treatment) were also abused. The packages were visually checked for gas production during a 60-day incubation period and tested for botulinal toxin. Spore and vegetative cell counts, aerobic total plate counts, product pH, residual nitrite depletion, and sorbate levels were also

monitored. Toxic samples frequently occurred without gas, and many samples showing gas were nontoxic. Added sorbate or added nitrite extended the time to detection of first gas-containing and first toxic samples. A combination of sorbate (0.26%) with reduced nitrite levels (40, 80 p.p.m.) extended this time further. None of the uninoculated packages was toxic, while the total number of toxic inoculated packages decreased with nitrite or sorbate in the formulations. 90% of the samples from the control treatment became toxic during the 60-day incubation period; 58.8% from the treatment with 0.26% sorbate; 22.0% from the treatment with 40 p.p.m. nitrite and 0.26% sorbate; none from the treatment with 80 p.p.m. nitrite and 0.26% sorbate; and 0.4% from the treatment with 120 p.p.m. nitrite. Low nitrite-sorbate combinations were thus effective in delaying botulinal toxin production in temp. abused bacon. IFT

65

Effects of various concentrations of sodium nitrite and potassium sorbate on color and sensory qualities of commercially prepared bacon.

Paquette, M. W.; Robach, M. C.; Sofos, J. N.; Busta, F. F. *Journal of Food Science* 45 (5) 1293-1296 (1980) [11 ref. En] [Cudahy Foods Co., 700 W. Clarendon Avenue, Phoenix, Arizona 85038, USA]

Pork bellies (270) were processed under regular commercial conditions utilizing various concn. (5 treatments) of sodium nitrite and potassium sorbate. Sliced bacon was stored at 4°C under vacuum and nonvacuum packaged conditions and evaluated by consumers for uncooked colour at 7, 14, 21, 35, and 49 days after slicing. Fried bacon slices were evaluated for flavour, texture, appearance, and overall desirability by a taste panel on a 9-point hedonic scale during 63 days storage at 4°C under vacuum-packaged conditions. Bacon samples formulated with sodium nitrite (40, 80, and 120 p.p.m.) were similar in fresh colour desirability during storage and were significantly more desirable than bacon formulated without sodium nitrite. Bacon formulated with 0.26% potassium sorbate in combination with 40 or 80 p.p.m. sodium nitrite was not significantly different ($p < 0.05$) from bacon formulated with 120 p.p.m. sodium nitrite and no potassium sorbate for colour and sensory qualities. IFT

66

The exposure of humans to nitrite.

Walters, C. L.

Oncology 37 (4) 289-296 (1980) [46 ref. En] [British Food Manufacturing Ind. Res. Assoc., Randalls Road, Leatherhead, Surrey KT22 7RY, UK]

Humans ingest nitrite in several forms and ways. This paper surveys these ways under headings including: distribution of nitrite food and the environment, use of nitrite as a food additive, distribution of ingested nitrite in vivo, nitrite derived from ingested nitrate, and nitrite derived from nitrate in drinking water. Levels of these compounds in food are quoted. Vegetables are the major source of nitrate exposure, nitrite being largely found as a food additive, to reduce risk of *Clostridium botulinum* toxigenesis. LH

67

[Ice cubes and the conditions under which they were used in Vigo in 1977-1979.]

Alvarez Seoane, G.

Alimentaria No. 114, 53-58 (1980) [11 ref. Es]

Samples of ice cubes produced in Vigo, Spain, for catering establishments were analysed for nitrite and ammonia contents and for counts of mesophilic and coliform bacteria in 1977, 1978 and 1979. Of 520 samples tested, NO_3 was found in 74%, 66.7% and 47.9% of samples for the 3 yr, resp. and NH_3 in 59.6%, 62.3% and 43.7%. Counts of mesophilic bacteria > 1000/ml were found in 43.3%, 36.4% and 26.9%, and coliforms were present in a 0.1 ml solution in 29.8%, 22.9% and 19.3% of samples. The water used for manufacture was unfit to drink according to Spanish legal requirements in 79.5%, 64.4% and 54.5% of cases. Conditions of ice cube production are considered unsatisfactory, and recommendations are made for improved standards of hygiene. JMa

68

Can pitting in green beans: relation to vacuum, pH, nitrate, phosphate, copper, and iron content.

Davis, D. R.; Cockrell, C. W.; Wiese, K. F.

Journal of Food Science 45 (5) 1411-1415 (1980)

[18 ref. En] [Dep. of Hort. Food Sci., Univ. of Arkansas, Route 11, Fayetteville, Arkansas 72701, USA]

Early Gallatin green beans were packed in 0.25 and 0.50/0.25 tinplate R-enameled cans with variations in vacuum and pH and with added levels of NO_3^- and PO_4 and were analysed for brine and slurry pH, NO_3^- , PO_4 , Cu, and Fe. The cans were then visually examined for pitting after storage at 30°C and room temp. The pH, NO_3^- , PO_4 , and Cu decreased significantly during storage and Fe showed a significant increase. The decrease in slurry pH and Cu was correlated with pitting severity. The increase in Fe content during storage correlated with pitting severity and possibly could be used as an indicator of pitting during prolonged storage. IFT

69

Influence of sodium nitrite, temperature, and lactic acid bacteria on the growth of *Brochothrix thermosphacta* under anaerobic conditions.

Collins-Thompson, D. L.; Rodriguez Lopez, G.

Canadian Journal of Microbiology 26 (12) 1416-1421 (1980) [28 ref. En, fr] [Dep. of Environmental Biol., Univ. of Guelph, Guelph, Ontario, Canada N1G 2W1]

In commercial vacuum-packed bologna, growth of *Brochothrix thermosphacta* was limited at 5°C during a 4-week storage period. Factors controlling the growth of this organism were associated in part with certain lactobacilli isolated from the meat. The lactic acid bacteria associated with the decline of *B. thermosphacta* and overall spoilage of vacuum-packed bologna were isolated and identified. The principal organisms were *Lactobacillus brevis*, *Lactobacillus buchneri*, *Lactobacillus plantarum*, *Lactobacillus viridescens*, *Leuconostoc mesenteroides*, and certain streptococci. In associated growth

experiments with *B. thermosphacta* at 5 and 15°C, *L. brevis* and *L. plantarum* showed the greatest antagonism towards the *Brochothrix* species. Studies with changes in incubation temp. (5 or 15°C) or nitrite levels (0-50 µg/ml) indicated that these two factors influence the antagonism but were minor compared with the influence of the lactic acid bacteria. AS

70

Residual nitrite and total microbial plate counts of hams as influenced by tumbling and four ingoing nitrite levels.

Mills, E. W.; Plimpton, R. F.; Ockerman, H. W.

Journal of Food Science 45 (5) 1297-1300 (1980)

[14 ref. En] [Dep. of Anim. Sci., Ohio State Univ., Columbus, Ohio 43210, USA]

Effects of tumbling and 4 ingoing nitrite levels [0, 40, 80, 120 p.p.m.] on residual nitrite and on surface and subsurface total plate counts were evaluated in defatted, cured hams. Total microbial counts of tissue obtained during the tumbling process and following cooking were not affected by tumbling. Hams with each of the 3 nonzero levels of nitrite had counts, prior to cooking, which were consistently lower than those for hams with no added nitrite. Residual nitrite in hams tumbled intermittently for 18 h was significantly lower than in nontumbled hams. Following cooking this difference in residual nitrite still existed, but was not significant. IFT

71

Diffusion of chloride, nitrite, and nitrate in beef and pork.

Fox, J. B., Jr.

Journal of Food Science 45 (6) 1740-1744 (1980)

[21 ref. En] [USDA E. Reg. Res. Cent., SEA-AR, 600 E. Mermaid Lane, Philadelphia, Pennsylvania 19118, USA]

Diffusion of sodium chloride, nitrite, and nitrate into beef, pork, and pork fat was studied by the porous disc technique. Total salt uptake and boundary concn. analyses were performed on beef. Various salt combinations and concn. and various muscles were studied. Chloride diffusion was normal by all 3 methods of analysis, but skew boundaries and decreased uptake of nitrite were observed in the boundary measurements; diffusion rates of nitrite were constant in the porous disc method. Nitrite diffused slower than chloride in meat, but the rate of nitrate diffusion was sometimes greater than that of chloride. Comparison of the results of the steady state diffusion with the total uptake and boundary concn. showed the diffusion of nitrite to be governed by both physical and chemical factors. IFT

72

Influence of tumbling and electrical stimulation on distribution and content of sodium nitrite and sodium chloride in bacon.

Ockerman, H. W.; Dowiercial, R.

Journal of Food Science 45 (5) 1301-1304 (1980)

[29 ref. En] [Anim. Sci. Dep., Ohio State Univ., Columbus, Ohio 43210, USA]

The purpose of this study was to evaluate the effect of electrical stimulation and tumbling on distribution and levels of NaNO_2 and NaCl in bacon [from

48 bellies]. Both factors resulted in a more even distribution of nitrite and chloride, but had no effect on their levels in bacon. The content of NaNO_2 and NaCl was highly related to the anatomical location and consequently the moisture content of the sample in the slab of bacon, and to storage time. In slices taken from areas with higher lean content, higher amounts of nitrite and chloride were found. After separation of slices into lean and adipose tissues, analyses indicated approx. one-third as much nitrite and chloride in the fat portion as in the lean. There was a reduction in nitrite during smoking. Concn. of both nitrite and chloride increased in nonpackaged, hanging bacon as a result of evaporation of moisture. IFT

73

Nitrite in cured meats: preventing illegal levels. Winstanley, M. A.

Food, Flavours, Ingredients, Packaging and

Processing 1 (11) 26-27 (1980) [2 ref. En] [ARC Meat Res. Inst., Langford, Bristol, UK]

A description is given of a new method developed by the Meat Research Institute, at Langford, Bristol, UK for screening out susceptible carcasses for high nitrite levels. Bacon of high ultimate pH and of normal pH were slice cured with either nitrate-free or nitrate-containing brines and stored in vacuum packs.

Microbiological conditions likely to occur in chemically similar bacons, produced by the traditional Wiltshire method, were introduced into half the packs using an inoculum from mature Wiltshire bacon sides.

Examination after storage showed inoculated, high pH packs cured with nitrate contained almost twice the permitted level of nitrite within 1 wk of storage. There was no comparable accumulation of nitrite under any of the other conditions. Possible solutions involve using rapid curing techniques, omitting nitrate from curing brines or screening out high pH carcasses. A hand held fibre optic probe designed by the Meat Research Institute, which detects meat of abnormal pH on the basis of its opacity, is quick and easy to use, enabling the screening of up to 200 carcasses/h. Detection of carcasses with high pH which are unsuitable for traditional curing could eliminate the risk of nitrite accumulation. VJG

74

Nitrite and nitrate in human nutrition. [Lecture] Sohar, J.; Domoki, J.

Bibliotheca 'Nutritio et Dieta' No. 29, 65-74 (1980) [45 ref. En] [Inst. of Nutr., Cyali-ut 3/a, Budapest IX, Hungary]

The action of nitrite and nitrate in the diet is briefly reviewed, and international standards for their regulation are discussed and compared to Hungarian requirements. The nitrate contents of leaf, and root vegetables and pulses, and the nitrite contents of celery, lettuce and spinach are tabulated, drawing data from a number of published sources. [See FSTA (1981) 13 9C296.] JRR

75

[Mineral components of D.O.C. Frascati wine.]

Pallotti, G.; Bencivenga, B.; Colaioni, G.; Graziani, A.; Palmioli, A.

Industria delle Bevande 10 (5) 408-409 (1980) [10 ref. It] [Lab. Provinciale di Igiene & Profilassi, Rome, Italy]

60 samples of Frascati wines of 1975-1979 were analysed for concn. of K and Na (flame photometry), Mg, Cu, Ca, Zn and Pb (AAS) and nitrates (Benassi's modification of Follet & Ratcliff's method [Journal of the Science of Food & Agriculture (1963) 14, 138]. Ranges and mean values are quoted (means are: K, 1006; Na, 65; Mg, 82; Cu, 0.53; Ca, 106; Zn, 0.67; Pb, 0.067 mg/l), together with s.d. and coeff. of variation (%). Metal contents, especially Pb, were very small, well

below permitted limits (except for Cu in 2 cases).

Nitrates contents (expressed as NO_3) were also low (mean, 2.1 mg/l); this parameter is deemed suitable for determining the genuineness of a wine. KME

76

Influence of raw ingredients, nitrite levels, and cooking temperatures on the microbiological quality of braunschweiger.

Chyr, C.-Y.; Walker, H. W.; Sebranek, J. G.

Journal of Food Science 45 (6) 1732-1735 (1980) [21 ref. En] [Dep. of Food Tech., Iowa State Univ., Ames, Iowa 50011, USA]

Of the main ingredients (pork liver, pork-trim, and salt-spice mixture) used for manufacturing braunschweiger, pork liver had the most influence on microbial numbers in the raw emulsion. The microflora of the raw sausage emulsion consisted mainly of enterococci, bacilli, lactobacilli, and pediococci. At 5°C, the raw emulsion underwent souring within 4 wk. Freshly cooked liver sausage usually contained 10^3 organisms/g; the most frequently recovered bacteria, in this instance, were bacilli, enterococci and pediococci. Nitrite was effective in inhibiting growth of enterococci capable of producing a perfumy odour in liver sausage. Sausage made from raw emulsion of good bacterial quality and stored at 5°C had a shelf life exceeding 16 wk. IFT

77

Determination of nitrite in cured meats by chemiluminescence detection.

Doerr, R. C.; Fox, J. B., Jr.; Lakritz, L.; Fiddler, W.

Analytical Chemistry 53 (2) 381-384 (1981) [13 ref. En] [E. Reg. Res. Cent., Sci. & Education Administration, USDA, Philadelphia, Pennsylvania 19118, USA]

An improved method for detn. of nitrite in foods is described, based on acidifying the sample with tartaric acid and complete decomposition of nitrous acid and other potential nitrosamine groups to nitric oxide, which is measured by chemiluminescence (CL). The method is compared with the standard Griess colorimetric and differential pulse polarographic procedures. Test materials were: (i) a pork meat:water 1:2 slurry containing 140 p.p.m. NaNO_2 ; (ii), (i) + 5.9% NaCl; (iii), (ii) + 550 p.p.m. or (iv) 2200 p.p.m. sodium ascorbate; (v), (ii) + 2400 p.p.m. cysteine; and (iii), (iv) and (v) without NaCl. Sodium ascorbate and cysteine

cause loss of nitrite in meat; some samples were analysed after charcoal treatment to eliminate ascorbate interference. Samples were also heated at 70°C for 1 h and stored 1 wk at 4°C to induce significant nitrite losses. Preliminary procedures and injection of nitric oxide into the CL detector are described. NaNO_2 detection limit was 2.5 parts/billion (p.p.b.) vs. 250 p.p.b. by Griess analysis. Precision of the method gave a coeff. of variation of 6.5%. NaNO_3 and Na_2SO_3 produced no adverse interference; butyl nitrite, *N*-nitrosodimethylamine and other alkyl nitrites could give some interference if present in concn. > 1 p.p.m. The Griess and polarographic methods gave lower values than the CL procedure, but agreement was better with samples given charcoal treatment. ELC

78

Color stability of radappertized cured meat.

Kamarei, A. R.; Karel, M.; Wierbicki, E.

Journal of Food Science 46 (1) 37-40 (1981) [16 ref. En] [Dep. of Nutr. & Food Sci., MIT, Cambridge, Massachusetts 02139, USA]

Porcine *semimembranosus* muscles were cured (with 10 different levels of nitrite, nitrate, and their combination, viz. 0-75, 0-75 and 25:25-25:75 p.p.m., resp.) smoked, and irradiated with 3.2 Mrad γ -radiation at -40°C. Subjective studies by a trained panel, objective studies of total colour difference (calculated from tristimulus values), and behaviour of residual nitrite and nitrate showed that radiation altered the pink colour of cured meats (radiation-induced fading). Contrary to prior reports, nitrate affected neither colour development nor post-irradiation fading. Colour of nitrate-cured samples, like uncured samples, became bright red when irradiated, due to reduction of globin myohemichromogen (indistinguishable from pink colour of cured meat), and therefore are more desirable. IFT

79

Factors affecting the acceptability of low-nitrite smoked, cured ham.

DuBose, C. N.; Cardello, A. V.; Maller, O.

Journal of Food Science 46 (2) 461-463 (1981) [15 ref. En] [Food Sci. Lab., US Army Natick R&D Command, Natick, Massachusetts 01760, USA]

2 experiments were conducted to evaluate consumer acceptance of samples of cooked, smoked ham which varied in NaNO_2 concn. and to evaluate the importance of 2 factors believed to affect their acceptability. The 1st experiment assessed the importance of colour to the overall acceptability of smoked ham. Results indicated that satisfactory colour in this product can significantly increase its acceptability, even when other attributes (e.g. flavour) of the product are inferior. The 2nd experiment assessed the effect of a warning of the possible dangers of NaNO_2 on the acceptability of the products. Results showed that the warning had no effect on consumer acceptance of the product.

80

Sensory, physical, and cooking characteristics of bacon processed with varying levels of sodium nitrite and potassium sorbate.

Berry, B. W.; Blumer, T. N.

Journal of Food Science 46 (2) 321-327 (1981) [11 ref. En] [USDA-SEA-AR Meat Sci. Res. Lab., Beltsville, Maryland 20705, USA]

Sensory, physical, and cooking properties were evaluated on bacon processed under commercial operations in 4 separate plants. 3 formulations with various levels of sodium nitrite and potassium sorbate were used: 0 p.p.m. sodium nitrite; 40 p.p.m. sodium nitrite-2600 p.p.m. potassium sorbate; and 120 p.p.m. sodium nitrite. Sliced bacon was evaluated after 10, 30, 50, and 70 days storage. "Chemical"-like flavours, prickly mouth sensations, and "sweet aromatic" aromas were found in bacon processed with 40 p.p.m. sodium nitrite-2600 p.p.m. potassium sorbate. "Microbial" flavours were found in 0 p.p.m. sodium nitrite bacon after 50 and 70 days storage. Bacon stored for 30 days had less cooking loss and sensory panel scores indicative of more mouth coating with fat than did bacon stored for 10 days. Degree of leanness in bacon strips had more influence on textural, physical and cooking characteristics than did sodium nitrite and potassium sorbate levels. IFT

81

Use of nitrates and nitrites as food additives in Nordic countries.

Poulsen, E.

Oncology 37 (4) 299-301 (1980) [En] [Inst. of Toxicology, Nat. Food Inst., Denmark 2860 Soborg, Copenhagen, Denmark]

An account is given of the permitted use of nitrates and nitrites as food additives in Denmark, Finland, Norway and Sweden. Nitrate is permitted in milk for the production of solid, semisolid and mould cheeses at levels of 150-200 mg/l potassium nitrate. Due to the potential formation of non-volatile N-nitroso compounds, attempts are made to reduce their use. Nitrates, but not nitrites, are still permitted in certain semipreserved fish products (herring) in Denmark, Finland and Sweden, but it will probably be phased out within a few yr. Nitrates are not permitted in meat products in Norway and Sweden, while their use is being reduced in Denmark and Finland. Nitrite (175-200 mg/kg meat product as sodium nitrite) is generally permitted as a preservative in meat products in Sweden, Finland and Denmark, while it is more restricted in Norway. Due to the potential risk of formation of carcinogenic N-nitroso compounds in the meat and the consumer, serious attempts are being made to reduce use of nitrite in all Nordic countries. AS

82

[Authorization of use of nitrite and nitrates in foods.]

Zulassung von Nitrit und Nitrat zu Lebensmitteln. Germany, Federal Republic of, Bundesminister für Jugend, Familie & Gesundheit

Zeitschrift für Lebensmittel-Untersuchung und -Forschung 172 (Beil. 3) 36-39 (1981) [De]

The text of a ministerial ordinance published 19 Dec. 1980 [*Bundesgesetzblatt I S.*, 2313] is published. This

ordinance contains amendments to food additive, meat and minced meat ordinances relating to use of nitrite curing salt. 3 annexes to the ordinance give the purity requirements for nitrite and nitrite curing salt, the text of required official documents accompanying shipments of nitrite curing salt, and permitted food uses and max. permitted levels of nitrite curing salt and potassium nitrate. DIH

83

Legal aspects of prevention.

Kothmann, G.

Oncology 37 (4) 297-298 (1980) [En]

[Bundesministerium für Jugend, Familie & Gesundheit, D-5300 Bonn, Federal Republic of Germany]

Legal aspects of the use of nitrates and nitrites in the manufacture of food products in the Federal Republic of Germany is discussed. Nitrite usage is dealt with in the 'Law on the use of nitrites in the trade in food (law on nitrites)' (1934, amended); and nitrates are covered by the 'Law on food and commodities' (1974) and several other regulations referring to specific foodstuffs. LH

84

Determination of trace amounts of nitrites in fabricated nonmeat products.

DeSiena, A.; Jacobs, E.; Romagnoli, R.

Journal of the Association of Official Analytical Chemists 64 (1) 226-227 (1981) [3 ref. En] [General Foods Corp., Tech. Cent., White Plains, New York 10625, USA]

Experiments leading to the organization of a system capable of quantifying low levels of NO_2^- in textured, high protein, high fat, nonmeat products, and their ingredients, are described. The method arrived at is based on the official AOAC technique; a sample size of 5 g is optimal and the procedure uses a balanced combination of clarifying agents (HgCl_2 , $(\text{NH}_4)_2\text{SO}_4$ and ethanol), prewashed filter paper, and high speed centrifugation as necessary (in persistent suspensions). 5 separate portions of a composite nonmeat product were analysed and NO_2^- contents estimated as 1.0, 0.6, 0.9, 0.8, 0.8 p.p.m. (0.82 p.p.m., mean); recovery was > 90% for samples to which 5-10 p.p.m. NO_2^- had been added. LH

85

[Colorimetric and gas-chromatographic determination of nitrate in foods using 2,6-xyleneol.]

Horio, T.; Sugiura, Y.

Journal of the Food Hygienic Society of Japan

[*Shokuhin Eiseigaku Zasshi*] 20 (6) 418-424 (1979)

[16 ref. Ja, en] [Toyo Inst. of Food Tech., 23-2

Minamihanayashiki 4-chome, Kawanishi, Hyogo, Japan]

Convenient colorimetric and gas-chromatographic methods for the detn. of nitrate in foods are presented. An aliquot of the test solution is mixed with sulphuric acid (3 + 1) and an alcoholic solution of 2,6-xyleneol, and the mixture is left to stand for 25 min at 37°C. Nitration

of 2,6-xyleneol occurs, and the nitroxyleneol extract in choloform can be used for colorimetry, after reextraction with 0.2M borate buffer, or for FID-gas chromatography. It was found that the absorption max. of nitroxyleneol in the buffer solution is 432 nm; the partition coeff. of nitroxyleneol with borate buffer and chloroform depends on the pH of the buffer. Taking advantage of this, the pH of the extracting solution can be varied in accordance with the amount of nitrate in the test solution; pH 8.0 is suitable for < 200 µg per tube, pH 8.5 for < 100 µg and pH 9.0 for < 30 µg. It was shown that these methods are not interfered with by nitrite. AS

86

[Determination of nitrates and proline in wines.]

Caporali, L.; Romagnani, M.

Bollettino dei Chimici dei Laboratori Provinciali 6 (S5) 609-611 (1980) [1 ref. It] [Lab. Chimico Provinciale di Livorno, Via Marradi 116, 57100 Livorno, Italy]

Tabulated results are presented from nitrate (expressed as N_2O_5) and proline analyses of 38 samples of wine (proline detn. were done in 2 successive yr on the same wine). N_2O_5 concn. ranged from 0 to 7 mg/l, proline from 380 to 1550 mg/l. RM

87

[Determination of nitrates in wines.]

Barbieri, G.; Beneventi, G.; Gavioli, E.

Rivista della Societa Italiana di Scienza

dell'Alimentazione 9 (6) 423-424 (1980) [20 ref. It, en] [Lab. d'Igiene & Profilassi, Reparto Chimico USL N. 16, Modena, Italy]

A rapid spectrophotometric method for detn. of NO_3^- in wines is described. 50 ml of wine are decoloured by addition of 1 g activated C and filtration. 20 ml of the filtrate are mixed with 25 ml $\text{NH}_4\text{Cl}/\text{CuSO}_4$ solution buffered to pH 8.5; 0.200 g powdered Zn/cadmium acetate reducing mixture are added, the mixture is agitated for 10 min. and filtered. 40 ml of the filtrate are then mixed, with 2 ml glacial acetic acid + 2 ml Griess reagent, and the extinction value is read against a blank at 522 nm after 30 min. Nitrate concn. is calculated by means of a standard curve. AJDW

88

Nitrate and nitrite levels in fruit and vegetables in New Zealand, and the effect of storage and pressure cooking on these levels.

Pickston, L.; Smith, J. M.; Todd, M.

Food Technology in New Zealand 15 (2). 11, 13, 15, 17 (1980) [26 ref. En] [Chem. Div., Dep. of Sci. & Ind. Res., Petone, New Zealand]

Toxicity of nitrite and nitrate from foods presents cause for concern in 2 distinct ways: nitrate can reduce the O_2 carrying capacity of the blood by transforming haemoglobin to methaemoglobin, a hazard particularly in the case of infants < 60 days old; and nitrites can react with amines to form nitrosamines, the majority of which are carcinogenic. Samples of fruits and vegetables (43 spp.) from 11 major growing areas,

(including 2 wild spp., watercress and puha, *Sonchus oleraceus*) were analysed for nitrate and nitrite after preparation as for normal consumption. Additionally, samples of beetroot, celery, silverbeet, cabbage and beans, which have high nitrate levels, were selected for the storage and pressure cooking experiments. Potatoes were also included, because of the vol. of consumption. Fruit was found not to be a significant source of nitrate or nitrite, the latter being undetected (<0.2 mg/kg). Nitrate was found to occur in greater quantities in some spp. but no overall pattern with respect to type was found. Only 2 vegetable samples (puha) had more than 1 mg/kg nitrite. Levels of nitrite formed in vegetables during storage were insignificant compared with other dietary sources. Pressure cooking reduced nitrate levels by approx. 20%, and nitrite to <0.2 mg/kg. Nitrite formation in the cooking water was not detected. JRR

89

[Measurement of and causes of variation in levels of nitrates and nitrites in cheese wheys.]

Guingamp, M. F.; Schwartz, A.; Linden, G. *Lait* 58 (577) 371-380 (1978) [17 ref. Fr, en] [IUT, Biol. Appliquee et Lab. de Biochimie Appliquee, Univ. de Nancy, Nancy 1, France]

Assays available for detn. of nitrates and nitrites are listed; the 2 most often used with whey, the Cd method and the xylenol (Xy) method [see FSTA (1971) 3 7A293], were compared. Repeatability of the Xy method depended on the source of reagent and was poorer than that of the Cd method. Repeatability of the Cd method was improved by rinsing the Cd column between each sample. When samples were analysed by both methods, values obtained by the Xy method tended to be lower than those by the Cd method. The Cd method was simpler to perform, and was considered the better of the 2. Levels of nitrates in 130 samples of dried whey taken in Nov.-Dec. 1977 were generally higher than levels in 130 samples taken from the same sources in Nov.-Dec. 1976. Only 1 of these samples contained nitrites. In another study levels of nitrates + nitrites relative to TS content were higher by a factor of 1.3-1.6 in dried whey samples than in the original liquid whey. When samples of liquid whey with pH 6.25 and TS content of 6% were concentrated to 30% TS using a rotary vacuum evaporator with water bath temp. of 60°, 65°, 70°, 75°, 80° or 85°C (70°C is used for this purpose industrially), corresponding concentration factors were 1.00, 1.00, 1.35, 1.47, 1.77 and 1.00, resp. JDr

90

Rapid determination of nitrite in meat products. I. Investigations with raw and cooked hams and with Kochwurst and Brühwurst products.

Honikel, K. O.; Egginger, R. *Fleischwirtschaft* 59 (3) 379-380 (1979) [En] [Bundesanstalt für Fleischforschung, 8650 Kulmbach, Federal Republic of Germany]

See FSTA (1979) 11 55794 for De version.

91

[Determination of nitrites and nitrates in meat products.]

Barbieri, G.; Gavioli, E.; Beneventi, G. *Rivista della Società Italiana di Scienza dell'Alimentazione* 9 (6) 425-426 (1980) [10 ref. It, en] [Lab. d'Igiene & Profilassi, Reparto Chimico USL N. 16, Modena, Italy]

Rapid methods are described for detn. of nitrate and nitrite in meat products. The product under test is homogenized, digested by boiling with 0.02M NaOH, cooled for 30 min to separate fat, clarified with $\text{ZnSO}_4/(\text{NH}_4)_2\text{SO}_4$, and the clarified solution is filtered. Nitrite is determined directly in this filtrate by addition of glacial acetic acid + Griess reagent, followed by spectrophotometric detn. at 522 nm. Nitrate is determined similarly after reduction to nitrite by means of Zn/cadmium acetate, detn. of total nitrite as above, and calculation of nitrate concn. by difference. Error is $<3\%$ of the theoretical value. AJDW

92

Physical and chemical characteristics of Braunschweiger as a result of processing variables.

Chyr, C.-Y.; Sebranek, J. G.; Walker, H. W. *Journal of Food Science* 45 (5) 1150-1152, 1160 (1980) [21 ref. En] [Dep. of Food Tech. & Anim. Sci., Iowa State Univ., Ames, Iowa 50011, USA]

The initial loss of nitrite in Braunschweiger [made originally with 50-156 p.p.m. nitrite] was greater than that reported for other meat products. Nitrite levels decreased slowly during refrigeration [to 3-18 p.p.m.]: after refrigeration for 20 days, residual nitrite was about 50% of that in the freshly cooked samples. Freezing and thawing of liver slightly increased the pH and water activity (a_w) of the final product. Addition of calcium-reduced dried skim milk caused a significant increase in pH and decrease in a_w in raw and cooked product. Increasing the fat levels in the product did not alter pH but did lower a_w . Increasing the fat content did not significantly influence thiobarbituric acid (TBA) values but exclusion of O_2 by the packaging material was important for maintaining low TBA values. IFT

93

Chemical aspects of mutagen formation by sorbic acid-sodium nitrite reaction.

Namiki, M.; Osawa, T.; Ishibashi, H.; Namiki, K.; Tsuji, K. *Journal of Agricultural and Food Chemistry* 29 (2) 407-411 (1981) [9 ref. En] [Dep. of Food Sci. & Tech., Nagoya Univ., Nagoya 464, Japan]

Effect of reaction conditions on yield of individual products in the reacted mixture of sorbic acid and sodium nitrite was investigated by using TLC and HPLC methods. It became clear that mutagenicity of the reaction mixture reached max. by the reaction at pH 3.5-4.2 is due to the formation of the product Y (1,4-dinitro-2-methylpyrrole) and ethylnitrolic acid (ENA). Yields of Y and ENA reached max. at 30 min (at 60°C), but ENA decreased thereafter. Y and ENA gave max. yield at 8-fold excess of nitrite to sorbic acid, but their formation was detected even by reaction at 1:0.5 molar ratio. These chemical results well explained the observed pronounced effects of reaction conditions on biological activities. Ascorbic acid and cysteine above certain levels inhibit effectively the mutagen formation in this reaction system. AS

94

[Study of some components of Rioja wines.]

Iniguez Crespo, M.

Semana Vitivinicola 35 (1757) 1143, 1145 (1980) [Es]

130 samples of red, white and rose Rioja wine from 2 seasons were analysed for proline, NO_3^- , glycerol and 2,3-butanediol. Results are tabulated by wine type and source (Rioja region: high, low and Alavesa). Global results for red, rose and white wines, resp., were: proline (mg/l) 517–2600, mean 1106 ± 8.78 ; 460–2400, 1280 ± 225.9 ; 460–1430, 818 ± 219.6 ; NO_3^- (mg/l) 0.3–6.7, 1.68 ± 0.24 ; 0.1–3.9, 1.33 ± 0.52 ; 0.1–2.7, 0.99 ± 0.58 ; glycerol (g/l) 5.1–12.7, 7.56 ± 0.26 ; 4.5–12.15, 8.01 ± 0.71 ; 5.5–10.0, 7.68 ± 1.07 ; and 2,3-butanediol (g/l) 0.33–0.96, 0.63 ± 0.02 ; 0.31–1.20, 0.79 ± 0.10 ; 0.31–0.94, 0.63 ± 0.11 . The methods of detn. are described and the oenological importance of each compound discussed (proline – index of adulteration; NO_3^- – maturity index; glycerol – purity index, adulteration; and 2,3-butanediol – aroma component). RM

95

Denitrification of water for human consumption.

Richard, Y.; Leprince, A.; Martin, G.; Leblanc, C.

Progress in Water Technology 12 (6) 173–191 (1980)

[13 ref. En] [Dep. of Physical-Chemical Res., Degremont SA, BP 46, 92151 Suresnes, France]

Nitrates contained in water destined for human consumption can be removed by a biological denitrification process using submerged, upward-flow type anaerobic filters. Depending on the rising velocity of the water and the support material's characteristics, these filters may consist of fixed or expanded beds. This paper describes the specific properties, results, and running conditions for filters using expanded beds. Under normal running conditions the amount of nitrates removed depends on the sludge's concn., the support material's concn., height, fluid velocity, and temp. Numerous formulae are given. AL

96

[Varietal differences in nitrate accumulation in carrots.]

Blanc, D.; Bouret, A.; Otto, C.; Mais, S.

Comptes Rendus des Seances de l'Academie

d'Agriculture de France 66 (6) 517–524 (1980) [5 ref.

Fr] [Sta. d'Agron. et de Physiol. Vegetale, INRA, 06602 Antibes, France]

The accumulation of nitrates in carrots was investigated in view of the 50 p.p.m. max. decreed for baby food. Var. Chantenay, Tip-top, Tantal and Scarla and 14 hybrid var. were grown with N fertilization of 30, 60, 150 and 300 kg N/ha. Tabulated results and analysis of variance showed the significant effect of var. For all treatments and harvesting dates, N contents of the 4 var. were Chantenay > Tip-top > Tantal > Scarla. The hybrids were classified into 2 groups by their NO_3^- content (750–818 and 483–522 p.p.m. resp.). RM

97

[Concentration of nitrates in milk.]

Buryakova, M.

Zhivotnovodstvo No. 2, 60–61 (1981) [Ru]

Ayrshire cows with a yield of 4%-fat corrected milk during a previous lactation of 4718 kg/305 days were in 3 groups and fed during their 2nd and 4th lactation on a ration of maize silage 25, grass hay 8, briquettes 1.2, barley meal 6.4, sunflower oilmeal 0.35 and molasses 0.90 kg; potassium nitrate was given at 0.20, (group 1), 0.95 (group 2) or 1.42% (group 3) of DM in diet, corresponding to 28.81, 135.06 or 211.16 g/cow daily. Before KNO_3 was added to the rations all 3 groups had physiologically normal concn. of carotene, vitamin A, nitrate N and urea in blood and milk. After 2 weeks of feeding on high- KNO_3 diets, cows in groups 2 and 3 had increased concn. of NO_3^- in blood 3 h after the morning feeding. The increases were greater with more KNO_3 in the diet. Similar increases occurred in blood urea, but serum vitamin A decreased in the 2 test groups compared with group 1 (control). Changes in NO_3^- , urea and vitamin A concn. of milk reflected those of blood. KNO_3 also caused increases of NO_3^- in dairy products. Greatest amounts of NO_3^- were in condensed milk (2.15, 7.06 and 7.74 mg% for groups 1–3 respectively) and lowest amounts in tvorog (1.09, 1.29 and 3.21 mg%). [From *Nutrition Abstracts and Reviews*]

98

[Nitrates and nitrites in Parmesan cheese.]

Monzani, A.; Parenti, C.; Plessi, M.; Coppini, D.

Scienza e Tecnica Lattiero-Casearia 32 (1) 7–20

(1981) [22 ref. It, en] [Istituto di Chimica Farmaceutica e Tossicologica, Univ., Modena, Italy]

Nitrate and nitrite contents are tabulated for Parmesan cheeses 6, 12 and 18 months old made in various lowland, hill and mountain districts. Nitrate contents/kg DM ranged from 0.14 to 4.48 mg, comparable to results reported in the literature for other types of cheese, but nitrite contents (0.32–2.83 mg/kg DM) were in some cases above the levels reported for other cheeses. Nitrate and nitrite contents tended to be higher in hill and mountain cheeses than in lowland cheeses and were in some cases also related to the age of the cheese. ADL

99

Estimation of straw usefulness in the aspect of milk quality improvement of cows fed with green crops out of high nitrogen fertilization. [Lecture]

Leonhard-Kluz, I.; Bielak, F.; Barabasz, J.; Zywezcok, H. *Paper, 30th Annual Meeting, European Association for Animal Production* No. C3.7, 5pp. (1979) [14 ref. En, de, fr] [Inst. of Zootechnics, 31-047 Krakow, ul. Sarego 2, Poland]

In initial and final periods of 2-wk 3 groups of 6 Red Pied Lowland cows were given cut grass from pasture fertilized with N at 92 kg/ha. In the trial period the cows were given in 3 periods of 2-wk grass from successive cuts of pasture fertilized with N at 240 kg/ha before each cut to give a cumulative treatment of N at

720 kg/ha. 2 groups received additional daily supplements of 4 kg of wheat chaff untreated or treated with 2.7% NaOH; the control group received only grass. N fertilization increased mean daily N-NO₃ intake from 6–10 g in the initial period, to 65 g, with no symptoms of toxicity. Fertilization significantly increased N-NO₃ secretion in milk; mean N-NO₃ content of milk from the control group rose from 62 µg/l in the initial period to 877 µg/l in the final experimental period (vs. 708.5 and 564.6 µg/l for cows given untreated or treated chaff). The amount of urea in milk was also increased by fertilization. Giving chaff slightly decreased the amount of N-NO₃ and urea in milk compared with the control group. Other differences in milk composition were much less marked but N fertilization tended to increase milk protein % and decrease fat % especially for control cows. Milk yield was not significantly influenced by treatment. [See FSTA (1981) 13 11S1888.] BWB

100

[Nitrites in meat products.]

Dakic, M.; Jovanovic, G.; Babic, L.

Hrana i Ishrana 21 (5/6) 113–115 (1980) [7 ref. Sh, en]
[Vet. Fak., Belgrade, Yugoslavia]

A total of 150 samples of meat products from shops in Belgrade was analysed for nitrite. Ranges of values for nitrite concn. (with number of samples studied in parentheses) were (mg%): cooked sausage (3) 0.1–0.5; scalded sausage (23) 0.6–16.5; non-ripened long-keeping-quality sausage (40) 0.2–15.2; ripened sausages (20) 0.06–8.2; cured backfat (9) 0.2–7.0; smoked meat products (19) 0.5–13.7; and canned meat products (36) 0.1–7.0. Results are presented in detail for various individual products within these groups. None of the samples studied exceeded current Yugoslavian tolerances for residual nitrite. The role of nitrite in nitrosamine formation is discussed, and the desirability of reducing residual nitrite concn. to the min. practical level is stressed. AJDW

101

Method of test for meat and meat products.

Determination of nitrate content.

Sri Lanka, Bureau of Ceylon Standards

Sri Lanka Standard SLS 396:1976, 13pp. (1976) [En]

Nitrate is extracted from a test portion of the sample with hot water and the proteins removed by precipitation and filtration. Nitrate is reduced to nitrite by metallic Cd and determined by measuring absorbance at 538 nm of the red colour developed by addition of sulphanilamide/HCl and N-1-naphthylethylene diamine dihydrochloride to the nitrite solution. AL

102

Method of test for meat and meat products.

Determination of nitrite content.

Sri Lanka, Bureau of Ceylon Standards

Sri Lanka Standard SLS 384:1976, 12pp. (1976) [En]

Nitrite is extracted from the test portion with hot water and the proteins removed by precipitation and filtration. Nitrite is determined by measuring absorbance at 538 nm of the red colour developed by addition of sulphanilamide-HCl and N-1-naphthylethylenediamine dihydrochloride to the filtrate. AL

103

Fate of ingested ¹⁵N-labelled nitrate and nitrite in the rat.

Wang, C. F.; Cassens, R. G.; Hoekstra, W. G.

Journal of Food Science 46 (3) 745–748 (1981) [21 ref. En]

[Dep. of Meat & Anim. Sci., Coll. of Agric. & Life Sci. Univ. of Wisconsin, Madison, Wisconsin 53706, USA]

104

[Spinning of plant and blood protein mixtures. I.

Coloration of protein fibres by nitrosylhaemoglobin.]

Culioli, J.; Noel, P.; Goutefongea, R.

Sciences des Aliments 1 (2) 169–185 (1981) [24 ref. Fr, en] [Sta. de Recherches sur la Viande, INRA, Theix, 63110 Beaumont, France]

Coloured protein fibres have been obtained by spinning haemoglobin and fababean protein mixed in the same dope. So as to obtain spun protein products similar in colour to meat products, haemoglobin was stabilized by action of nitrite. The nitrosylation of the haem was achieved either before incorporation of haemoglobin into the spinning dope or after spinning by soaking the fibres in a brine. In both cases the coloration studied by reflectometry was satisfactory. The influence of pigment concn., curing and storage conditions has been studied. The characteristics of the colour of the spun products could be modified to resemble a large range of products, including cooked ham and red meat. Whatever the process, the fibres had free nitrite contents lower than those generally found in traditional cured meat products. AS

105

[Physicochemical criteria applicable to foods of animal origin.]

Cumont, G.

RTVA 20 (166) 28–31 (1981) [Fr] [Lab. Cent. d'Hygiene Alimentaire, 43, Rue de Dantzig, 75015 Paris, France]

Aspects considered include: contaminants (with special reference to heavy metals); additives; general purity criteria for additives; specific purity criteria for various additives; sources of contamination; changes in contents of additives and contaminants at various stages of production and processing; criteria for the composition of meat products etc.; and criteria for concn. of residues of certain additives (with special reference to nitrites and nitrates in meat products). AJDW

106

[Nitrite in relation to bacterial and enzymic digestion of meat.]

Bianchi, M. A.; Porrini, M.; Cantoni, C.; Testolin, G.; Soncini, G.

Archivio Veterinario Italiano 32 (1/2) 27-30 (1981) [4 ref. It, en] [Istituto di Ispezione degli Alimenti di Origine Anim., Univ. degli Studi di Milano, Milan, Italy]

Samples of minced beef were mixed with 2.5% NaCl, with or without 150 p.p.m. NaNO₂, sterilized, inoculated with 1 strain of *Clostridium perfringens* or 2 strains of *Cl. putrefaciens*, and incubated at 32°C for 24 or 48 h, proteolysis being evaluated on the basis of the quantity of NH₃ released. No significant difference in NH₃ release was observed between samples with and without NaNO₂. Similar studies were conducted with minced beef with or without 200 p.p.m. NaNO₂, which were sterilized then incubated with pancreatin for 3 or 6 h at 37°C, proteolysis being evaluated by detn. of liberation of N fractions not precipitable with trichloroacetic acid. No significant effect of NaNO₂ on enzymic digestion of the meat proteins was observed. AJDW

107

Role of nitrite in cured meat flavor: a review.

[Review]

Gray, J. I.; MacDonald, B.; Pearson, A. M.; Morton, I. D. *Journal of Food Protection* 44 (4) 302-312, 319 (1981) [102 ref. En] [Dep. of Food Sci. & Human Nutr., Michigan State Univ., East Lansing, Michigan 48824, USA]

Little is known about the mechanism of the reactions leading to formation of cured meat flavour or of the identity of volatile and non-volatile substances responsible for it. This review of the contribution of nitrite to cured meat flavour in products such as ham, bacon and frankfurters includes sensory analyses and studies of the chemical components contributing to cured meat flavour. The antioxidant properties of nitrite in retarding development of warmed-over flavour in cured meats are also discussed. AS

108

Pilot studies of the membrane toxicity and chemical reactivity of combinations of sorbates and nitrite in a processed food. [Lecture]

Hinton, D. M.; Brouwer, E. A.; Vocci, F. J.; Joshi, A.; Yang, G.; Ruggles, D. I.

Federation Proceedings 40 (3, II) 878 (1981) [En] [FDA, Washington, DC 20204, USA]

Experimental bacon processed on a commercial scale containing either: (i) 2600 p.p.m. potassium sorbate, 40 p.p.m. nitrite; (ii) 120 p.p.m. sodium nitrite alone or (iii) neither sorbate nor nitrite were tested in a possible new animal model for evaluating irritation effects of foods on mucous membranes. The hamster cheek pouch was utilized to assess prolonged exposure (3 h) of the cooked products. Drippings and meat were tested for effects on haemorrhagic potential, vascular integrity, and gross membrane constituency. Statistically significant results in a Kruskal-Wallis 1-way analysis of variance were obtained for semi-quantitative visual scores for both processes A and B compared to C. No

difference between A and B was seen, however.

Solutions of nitrite alone scored higher as a potential irritant compared to either sorbate alone, combinations of sorbate and nitrite, or nitrosamines. Both sorbate and nitrite, however, are potential membrane irritants. Solutions of sorbate and nitrite alone were reactive between pH 6 and 7, simulating reactivity of brines. Chemical reactivity of sorbate and nitrite was demonstrated by spectral analysis and by electron spin trapping of sorbate free radicals formed by reaction with nitrite. A postulated mechanism involves addition of nitrite to either of the double bonds of sorbate. [See FSTA (1981) 13 12A755.] AS

109

[New regulations on the use of curing agents.] Die neue Regelung über die Verwendung von Pökelfstoffen. Linke, H.

Fleischwirtschaft 61 (5) 677-681; 772 (1981) [many ref. De, en] [Bundesanstalt für Fleischforschung, 8650 Kulmbach, Federal Republic of Germany]

The Federal Republic regulations permitting the use of nitrite and nitrate in foods, dated 19th Dec. 1980 (BGBl. 1, 2313) transfer the provisions of the Nitrite Act to the Food and Commodities Act, and at the same time take account of current information on the toxicology of nitrosamines in meat products. The total nitrite supplied from consumption of meat products is lowered as a health protection measure (reduction of nitrite in curing salt, limiting residue levels), the use of saltpetre (KNO₃) is drastically limited and the definition of uncured meat products of Frankfurter and meat ball types (as interpreted by the trade, food scientists, inspectors, consumers etc.) is standardized. AS

110

[Order permitting the use of nitrite and nitrate in foods. Changes in regulations for meat products.] Verordnung über die Zulassung von Nitrit und Nitrat zu Lebensmitteln. Geänderte Vorschriften über die Verwendung von Nitrit und Nitrat bei Fleischerzeugnissen.

Böhm, H. D.; Scholz, H. D.

Fleischwirtschaft 61 (5) 669, 672-674; 772 (1981) [De, en] [Deutschherrenstrasse 87, D-5300 Bonn 2, Federal Republic of Germany]

The authors report on changes in Federal German regulations governing the use of NO₂ and NO₃ in the manufacture of meat products. These are mainly related to reducing the NO₂ content in curing salt by about 20% and limiting its application in the manufacture of meat products. Use of saltpetre (KNO₃) has been restricted to certain meat products, and use of NaNO₃ has been discontinued. Max. quantities have been laid down for residual NO₂ and NO₃ in the finished products (up to 600 mg KNO₃/kg permitted for large uncooked hams, and up to 100 mg KNO₃/kg for uncooked sausages). Since this order became effective, there have been changes or additions to the orders governing the distribution of additives, minced meat and diet foods. The Nitrite-Act is no longer in force. AS

111

[New laws for use of nitrite and nitrate. What has changed?] Neue Gesetze für die Verwendung von Nitrat und Nitrit – Was hat sich geändert?

Frey, W.

Fleischerei 32 (4) 300, 302-304 (1981) [De] [Raps & Co., Adalbert-Raps-Strasse 1, D-8650 Kulmbach, Federal Republic of Germany]

The new Law on Nitrate and Nitrite in Meat Products, which came into force in the Federal Republic of Germany on 1 Jan. 1981, is discussed. Aspects considered include: reduction of the nitrite content of nitrite curing salt; prohibition of use of nitrite curing salt in specified products; restrictions on use of KNO_3 ; prohibition of use of nitrate or nitrite in minced meat products; and tolerances for residues of nitrates and nitrites in meat products. Effects of these changes on the manufacture and characteristics of various types of meat and sausage product are described, and measures to minimize problems are suggested. AJDW

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FAB 48

NITRATES AND NITRITES IN MEAT PRODUCTS

SELECTED FROM VOLUME **14**

FOOD SCIENCE AND TECHNOLOGY ABSTRACTS

under the direction of:-

Commonwealth Agricultural Bureaux, Farnham Royal, Slough, Gesellschaft für Information und Dokumentation, Frankfurt am Main; Institute of Food Technologists, Chicago; Centrum voor Landbouwpublikaties en Landbouwdocumentatie (Pudoc), Wageningen.

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Titles of the FABs now available are given on the back cover of this booklet. For up-to-date lists of FABs or suggestions for new topics please write to the address on the back cover. New subjects are searched for at least the five most recent volumes of Food Science and Technology Abstracts. Thereafter each FAB is updated monthly. Copies of each month's abstracts on any topic may be obtained as indicated on the back cover of this publication. At the end of each volume of up-dating, the abstracts are merged and made available as a separate supplement to the original FAB.

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Copies of all original articles referred to in the abstracts may be bought (or occasionally borrowed) from the International Food Information Service. A form for ordering these is provided at the end of this FAB.

Coverage of the subject has been restricted to that of Food Science and Technology Abstracts, which covers over 1200 of the important food journals, patents from 20 countries and books published world-wide. Every effort is made to include all significant references, but editorial discretion is used on the many articles of borderline interest. If the reader particularly needs an exhaustive search of the subject, we will be pleased to provide any other references that we have available. We would, in any case, encourage readers to write or telephone us with any comments or queries that they may have.

H. BROOKES
EDITOR

1

The distribution and movement of solutes derived from agricultural land in the principal aquifers of the United Kingdom, with particular reference to nitrate. Young, C. P.

Water Science and Technology 13 (4/5) 1137-1152 (1981) [45 ref. En] [Medmenham Lab., Water Res. Cent., PO Box 15, Medmenham, Marlow, Bucks., UK]

Possible health implications from increased nitrate concn. in groundwater supplies from certain areas have given rise to concern by water supply undertakings and public health authorities. An extensive site investigation programme in outcrops of the chalk and Triassic sandstone aquifers in the UK is described; it shows high concn. of nitrate and other nutrients in aquifers beneath arable farming regimes, whereas low nitrate concn. are present beneath permanent grass and woodland. AL

2

[Nitrate contents of some selected vegetables.]

Untersuchungen über Nitratgehalte in einigen ausgewählten Gemüsearten. [Lecture]

Wedler, A.

Landwirtschaftliche Forschung, Sonderheft No. 36, 128-137 (1980) [24 ref. De] [Bundesforschungsanstalt für Ernährung, Rüdesheimerstrasse 12-14, D-6222 Geisenheim, Federal Republic of Germany]

The effects of var., location, maturity and fertilization on the NO_3^- contents of selected vegetables were investigated. Tabulated data are presented from 4-yr trials on celeriac, potatoes, beetroot, mangolds (leaf and stem types), and savoy cabbage. Very low concn. were found in celeriac bases (mean 1-9 mg/100 g fresh matter), with max. 20 mg/100 g. Somewhat high NO_3^- concn. were found in potatoes, max. 30 mg/100 g. High annual fluctuation masked any effects of var. or location. Concn. in beetroot were affected mainly by location, less by var. (means in 3 locations 100, 300 and 450 mg/100 g). High NO_3^- concn. were found in mangolds (winter crop, greenhouse grown), i.e. 352-658 mg/100 g in leaf var., 366-704 mg in stem var. with higher concn. in the stems (572-895 mg/100 g). Much lower concn. were observed in early summer crop grown in the open, i.e. 10 and 144 mg/100 g in leaf var., 65 and 221 in stem var. (2 locations). Decreasing NO_3^- concn. were observed in the outer leaves and the head of early Savoy cabbage with increasing growth. In beetroot growth trials, NO_3^- concn. was shown to be dependent on fertilization, and directly related to size. [See FSTA (1982) 14 1A23.] RM

3

[Nitrate content in some vegetables.] Der Nitratgehalt in einigen Gemüsearten. [Lecture]

Venter, F.

Landwirtschaftliche Forschung, Sonderheft No. 36, 138-144 (1980) [34 ref. De, en, fr] [Tech. Univ. München, D-8050 Freising-Weihenstephan, Federal Republic of Germany]

NO_3^- concn. and distribution were examined in various fruit, root, tuber and leaf vegetables. On the whole, lowest concn. were observed in fruits (e.g. tomatoes 20-100 mg/kg fresh wt., cucumbers 20-300 mg/kg) and highest in leaves (e.g. lettuce 382-3520,

spinach 349-3890 mg/kg). NO_3^- is not uniformly distributed in the plant: higher levels were found in leaf stalks and veins of outer leaves than in inner leaves, and lowest concn. in the lamina, flower buds and fruits. [See FSTA (1982) 14 1A23.] RM

4

[Fertilizing effect of an organic nitrogenous fertilizer (N-lignin) in comparison with calcium ammonium nitrate on yield and quality of vegetables.]

Düngewirkung eines organischen Stickstoffdüngers (N-Lignin) im Vergleich zum Kalkammonsalpeter auf Ertrag und einige Qualitätsmerkmale von Gemüse.

[Lecture]

Rasp, H.

Landwirtschaftliche Forschung, Sonderheft No. 36, 170-186 (1980) [31 ref. De, en, fr] [Landwirtschaftliche Untersuchungs- & Forschungsanstalt Speyer, Oben Langgasse 40, D-6720 Speyer, Federal Republic of Germany]

The effects of N fertilization with 60, 120, 180 or 240 kg/ha mineral or organic N and 360 or 480 kg/ha organic N on crop yields and composition were examined in 3-yr studies with spinach, lettuce, carrots, asparagus, red and white cabbage. Tabulated results showed that NO_3^- in spinach increased during the season; organic N supply caused much smaller NO_3^- concn. than mineral N, but the latter did not always have an adverse effect. The form of N fertilization had no effect on essential amino acid composition. Oxalate concn. fluctuated within fairly narrow limits (4.75-8.40% in DM at 1 location, harvested in April, 8.5-11.4% at another location in June, 8.42-9.62% in Sept.). In lettuce, organic N produced higher NO_3^- concn. than mineral N. In carrots β -carotene concn. increased with N fertilization, either organic or mineral, while N contents were not affected. In beans, total and NO_3^- N increased with N fertilization of the previous crop (spinach). N contents of asparagus were not uniformly affected by N application. In white cabbage, increasing organic N (but not mineral N) resulted in higher total N contents in the young plants; organic N resulted in higher P contents. In red cabbage, no clear relationship was observed between N-fertilization and total N contents. [See FSTA (1982) 14 1A23.] RM

5

Changes in the nitrate and nitrite contents of fresh vegetables during cultivation and postharvest storage.

Lin, J.-K.; Yen, J.-Y.

Food and Cosmetics Toxicology 18 (6) 597-603 (1980) [27 ref. En] [Inst. of Biochem., Coll. of Med., Nat. Taiwan Univ., Taipei, Taiwan]

Nitrate and nitrite levels in both germinating seeds and growing vegetables were determined for the following vegetables: short-petioled cabbage (*Brassica chinensis*), long-footed cabbage (*Brassica chinensis* var. *communis*), field mustard (*Brassica campestris*), broad-leaf mustard (*Brassica juncea* var. *rugosa*) and water convolvulus (*Ipomoea aquatica* Forsk.). The seeds contained 16-32 p.p.m. N in the form of nitrate and 0.3-0.8 p.p.m. N in the form of nitrite. The nitrate N concn. of the growing vegetables varied between 300 and 1200 p.p.m. depending on species and their nitrite N contents were about 0.3-3 p.p.m. The N fertilizer urea seemed to

induce remarkable nitrate accumulation in the growing vegetables. The influence of storage at different temp. on the nitrate and nitrite contents of fresh and homogenized vegetables was studied. During the first few days storage at temp. of -10 or 2°C little change in the nitrate and nitrite conc. was found. However during the first few days of storage at 26 or 32°C the nitrite concn. increased considerably while the nitrate concn. decreased. Nitrate reductase and nitrite reductase activities in the vegetables were estimated at various stages of growth but no significant changes in activity were observed. In view of the effect of dietary nitrate on salivary nitrite formation and on the endogenous formation of carcinogenic *N*-nitroso compounds, we suggest that more effort should be put into developing methods of cultivating low-nitrate vegetables. AS

6

[Determination of nitrates in molasses stillage.]
Il'ina, L. D.; Sitnik, N. G.

Fermentnaya i Spirtovaya Promyshlennost' No. 2, 6-7 (1981) [10 ref. Ru] [UkrNIISP, USSR]

Modified photolorimetric method for detn. of nitrates in molasses and spent molasses is based on nitration of salicylic acid by nitrates in the presence of H_2SO_4 , the picric acid formed being alkalized to form a green-yellow picrate. The sample is first decolorized by activated C in a hot water bath. The procedure is described in detail. Contents of nitrates in molasses fluctuated between 0.05 and 0.1%. The method is quick (15 min), sufficiently sensitive (0.002 mg) and accurate ($\pm 5\%$). It is suitable for quality control of raw material during the production of baker's and fodder yeasts. STI

7

[Occurrence of nitrate and nitrite in milk and milk products - an analysis of the present situation.] Zum Vorkommen von Nitrat und Nitrit in Milch und Milcherzeugnissen - eine Situationsanalyse.

Nijhuis, H.; Heeschen, W.; Blüthgen, A.; Tolle, A. *Milchwissenschaft* 35 (11) 678-680 (1980) [10 ref. De, en] [Inst. für Hygiene der Bundesanstalt für Milhforschung, Kiel, Federal Republic of Germany]

The WHO permissible max. daily intake is 5 mg nitrate and 0.2 mg nitrite per kg body wt. This represents an acceptable daily intake (ADI) per person of about 48 mg nitrate-N. For 248 samples of raw milk and 375 of pasteurized milk the mean nitrate-N contents were 0.18 and 0.38 mg/kg resp.; no nitrite was detected. Milk products contained mean nitrate N and nitrite N of 0.3-0.83 and 0.002-0.14 mg/kg, resp. Since milk and milk products contribute no more nitrate N than 100 μg /person, this represents only about 2% of the ADI. BR

8

[Changes in the nitrite content of curing brines.]

Veränderung des Nitritgehalts in der Lake.

Winter, F. F.

Fleischerei 32 (4) 322-324, 327 (1981) [1 ref. De]

Aspects discussed include: reduction of nitrate to nitrite; microorganisms promoting this reduction; effects of pH; changes in the microflora in brines and meat products during curing; effects of redox potential on reduction of nitrate; effects of curing time and temp.; reaction of nitrite with myoglobin and other constituents of meat; development of the characteristic 'cured meat' flavour; and nitrosamine formation. AJDW

9

[Effect of various factors on variations of nitrite content of meat.]

Djordjevic, V.; Vuksan, B.; Radetic, P.; Hak, D.; Mitkovic, M.

Tehnologija Mesa 21 (10) 287-290 (1980) [11 ref. Sh, en] [Jugoslovenski Inst. za Tehnologiju Mesa, Belgrade, Yugoslavia]

Samples of pork leg and other meats were comminuted and homogenized; the mass was then divided into 3 parts, which were adjusted to pH of 5.3, 5.8 or 6.3. The meat was held under refrigerated conditions for 24 h; 2% NaCl was then added, together with 10 or 20 mg NaNO_2 or NaNO_3 /100 g. The mixtures were then filled into cans, sealed, and sterilized at 120°C or pasteurized at 80°C . Contents of nitrate and nitrite were determined in the canned products after storage at $2-4^{\circ}\text{C}$ for 6, 12 or 45 days. Results are presented diagrammatically. Residual nitrite concn. were higher in pasteurized than in sterilized samples; decomposition of nitrite increased with decreasing pH. Nitrate formation is proportional to added nitrite concn. STI

10

[Stability of NaNO_2 in brines.]

Radovic, N.; Jovanov, M.; Mrdjanov, J.

Tehnologija Mesa 21 (10) 291-293 (1980) [4 ref. Sh, en] [Jugoslovenski Inst. za Tehnologiju Mesa, Belgrade, Yugoslavia]

10 mg NaNO_2 and 50 mg NaNO_3 were dissolved in 100 ml water; 15% NaCl and 4% phosphate were then added. Stability of NaNO_2 was then determined in (i) the brine without added meat, (ii) brine + 50 ml meat juice/l, and (iii) brine with 500 g frozen veal/l. The residual NaNO_2 concn. was determined after holding of the brines at 2°C for ≤ 10 days. After 10 days, the % retention of NaNO_2 was 78.65 for (i), 65.15 for (ii) and 37.38 for (iii). STI

11

[Nitrates and nitrites as additives in the meat industry.]

Djordjevic, V.

Tehnologija Mesa 21 (10) 274-277 (1980) [52 ref. Sh, en] [Jugoslovenski Inst. za Tehnologiju Mesa, Belgrade, Yugoslavia]

Use of nitrites and nitrates in meat products is discussed with reference to: effects on colour, flavour, aroma and keeping quality; toxicity; nitrosamine formation; reaction of nitrites and nitrates with other compounds; effects of NaCl, polyphosphates and ascorbic acid on reactions of nitrates and nitrites; and the legal status of nitrites and nitrates in various countries. STI

12

Effects of sodium nitrite, sodium nitrate and DL- α -tocopherol on properties of irradiated frankfurters.

Terrell, R. N.; Heiligman, F.; Smith, G. C.; Wierbicki, E.; Carpenter, Z. L.

Journal of Food Protection 44 (6) 414-417, 421 (1981) [25 ref. En] [Dep. of Anim. Sci., Texas A&M Univ., College Station, Texas 77843, USA]

Frankfurters were manufactured to contain certain combinations of curing ingredients (NaNO_2 , NaNO_3 and DL- α -tocopherol). Frankfurters contained in the finished product either 0 or 10% added moisture; some frankfurters were not irradiated, others were irradiated with either 0.8 or 3.2 Mrad (^{60}Co radiation source). Use of DL- α -tocopherol (at 206 p.p.m.) was associated with greater processing shrinkage, more off-flavour and less overall palatability ($P < 0.05$). The most desirable external and internal cured colour and firmest texture was in frankfurters made with 50 p.p.m. of NO_2 or with 100 p.p.m. of NO_2 , irrespective of irradiation level. Use of irradiation (0.8 or 3.2 Mrad) on frankfurters made without nitrite or nitrate did not improve visually determined cured colour but did improve this colour when determined spectrophotometrically; nevertheless, cured colour of irradiated frankfurters made without use of nitrite or nitrate was not comparable to that of non-irradiated or irradiated frankfurters made with 100 p.p.m. NO_2 . Irrespective of added moisture or curing ingredient combinations, significant differences ($P < 0.05$) in palatability traits were associated with increasing irradiation levels (0, 0.8 or 3.2 Mrad). Off-flavour increased, texture was less firm and overall palatability was less desirable as irradiation level increased. Low-dose irradiation (≤ 1 Mrad) may be feasible for enhancing the palatability traits of frankfurters containing lower levels of nitrite (< 156 p.p.m.) but it appears that the correct irradiation level would be lower than the 0.8 Mrad used in this study. AS

13

[Studies on the physicochemical and textural characteristics of locally produced processed meat.]

Kim, J. W.; Lee, S. K.; Ahn, B. Y.; Lee, Y. B.

Korean Journal of Animal Science [Hanguk Ch'uksan Hakhoe Chi] 23 (1) 47-53 (1981) [8 ref. Ko, en] [Korean Inst. of Sci. & Tech., Seoul, S. Korea]

24 locally processed meat and fish items were analysed for physicochemical and textural characteristics. Proximate composition of fish sausage, frankfurter, bologna sausage, smoked ham, boiled pressed ham, loin ham, and boneless ham is tabulated (moisture, crude protein, fat and ash). Nitrite content ranged between 10 and 40 p.p.m. Warner-Bratzler shear values of meat sausage averaged 0.23 ± 0.1 (kg), of fish sausage 0.35 ± 0.1 , and of ham 1.69 ± 0.5 . Hardness varied widely among the products, but springiness was fairly uniform. Cohesiveness values were much larger for sausage than for ham. [From En summ.] LH

14

New nitrite regulation of the Federal Republic of Germany.] Neue Nitrit-Verordnung der Bundesrepublik Deutschland.

Leistner, L.

Fleischwirtschaft 61 (2) 252-254; (3) 338, 341-342, 344, 346 (1981) [33 ref. En, De] [Bundesanstalt für Fleischforschung, 8650 Kulmbach, Federal Republic of Germany]

Based on research at the Kulmbach Meat Research Institute into microbiological, technological, chemical and legal aspects of NO_2 and NO_3 additions to meat products, requirements recommended for safety of fully preserved, $3/4$ -preserved and semi-preserved canned meats, heated and fermented sausages (NO_2 addition, heat processing, storage temp.), and the recommended code of practice for production of raw ham (especially bone-in ham) in the Federal Republic of Germany are tabulated. The former and new (Dec. 31st. 1980) NO_2/NO_3 regulations are also discussed. The main differences are: NO_2 additions to meat products have been reduced by 20% (from 0.5-0.6 to 0.4-0.5% NaNO_2 in NO_2 curing salt); max. residues ≤ 100 p.p.m. NaNO_2 (150 p.p.m. in large, raw hams) have been established; NO_2 is banned in minced meat for raw consumption; meat products traditionally made without NO_2 or NO_3 are not regulated; a level of 600 p.p.m. KNO_3 or 300 p.p.m. KNO_3 in combination with NO_2 curing salt has been set for large hams; KNO_3 , as alternative to NO_2 curing salt in long-ripened fermented sausages must be ≤ 300 p.p.m. (residual $\text{NO}_2 + \text{NO}_3 \leq 100$ p.p.m.); and KNO_3 in low-Na special meat products must be ≤ 300 p.p.m. (residual $\text{NO}_2 + \text{NO}_3 \leq 100$ p.p.m.). RM

15

[Determination of nitrates and nitrites in animal products.] [Lecture]

Frouin, A.; Jondeau, D.; Bidard, J.-P.; Joannes, M.
Annales de la Nutrition et de l'Alimentation 34 (5/6)
765-778 (1980) [many ref. Fr, en] [Soc. Olida, 50 Rue
Raspail, 92304 Levallois-Perret, France]

Currently used methods of extraction, purification and detn. of NO_2^- and NO_3^- are briefly described, including 13 methods of NO_2^- detn. (5 of which have been successfully applied to meat products) and 18 for NO_3^- detn. (12 applied to meat products). The need for better extraction and purification methods is emphasized. [See FSTA (1982) 14 3A149.] RM

16

Role of nitrates in the corrosion of tin plates processed food cans - A review. [Review]

Chakravorty, S. C.; Ghosh, B.

Indian Food Packer 35 (2) 70-75 (1981) [20 ref. En]
[Metal Box India Ltd., Calcutta, West Bengal, India]

This review covers nitrate as detinner; mechanism of nitrate-induced detinning; factors affecting nitrate-induced detinning; and control of nitrate-induced detinning. CFTRI

17

[Role of mercuric chloride in nitrite determination.]

Die Rolle des Quecksilberchloride bei der Nitritbestimmung.

Bousset, J.

Fleischwirtschaft 60 (7) 1325-1326; 1350 (1980) [5 ref. De, en] [Lab. de Recherches sur la Viande de l'INRA, CNRZ, F-78 350 Jouy-en-Josas, France]

The effect of HgCl_2 on the liberation of bound NO_2^- in detn. of total NO_2^- (free and bound) was investigated in raw (Salami, bacon and dry sausages) and cooked ("Paris ham") meat products. Results, shown graphically and in tables, revealed that the effect increased with increasing Hg concn., was greater in raw than in cooked meat products, increased with storage time of the raw products, and was particularly pronounced when HgCl_2 was added during extraction of NO_2^- . A concn. of 4mm HgCl_2 is recommended. Free NO_2^- should also be determined. The proposed method is applicable only to the products examined, and cannot be applied unchanged to other or differently treated products without prior investigation. RM

18

[Nitrite and nitrate residues in cooked French meat products.] [Lecture]

Durand, P.; Vendeuvre, J. L.

Annales de la Nutrition et de l'Alimentation 34 (5/6)
1019-1023 (1980) [Fr, en] [Cent. Tech. de la Charcuterie, de la Salaison & des Conserves de Viandes, 94700
Maison-Alfort, France]

1256 samples of the most popular French meat products, i.e. 435 saucissons cuits (cooked coarsely ground sausages), 226 Strassburger and 165 Frankfurter sausages (finely ground) and 430 country-style pates were analysed. Tabulated data show the NO_2^- and NO_3^- contents for each type of product (from industrial or small-scale production and from consumers). While mean values were always lower than permitted levels,

the results ranged widely, especially for NO_3^- content. highest NO_3^- levels were found in cooked sausages and in pates from small-scale producers, (mean 405 and 264 mg NO_3^- /kg, resp.), probably due to the 'reddening salts' used. The total range of NO_2^- contents was 11-60 mg/kg, NO_3^- contents 90-405 mg/kg. There was not correlation between high NO_2^- and high NO_3^- contents. [See FSTA (1982) 14 A149.] RM

19

[Antimicrobial effects of nitrites in meat products.] [Lecture]

Jouve, J.-L.; Carlier, V.; Rozier, J.

Annales de la Nutrition et de l'Alimentation 34 (5/6)
807-826 (1980) [many ref. Fr, en] [Ecole Nat. Vet.
d'Alfort, 94704 Maisons-Alfort Cedex, France]

This review shows the important effect of NO_2^- on the safety and stability of cured meat products. In uncooked products, it has a synergistic effect with pH. NaCl concn. and storage temp. Min. concn. of 150 p.p.m NO_2^- are necessary. NO_2^- is also recommended for cooked products but it is difficult to establish quantitative requirements. There is general agreement that curing without NO_2^- would increase the risk of food poisoning, especially botulism, but also by *Clostridium perfringens* and *Staphylococcus aureus*. [From En summ.] [See FSTA (1982) 14 3A149.] RM

20

[Analytical problems related to nitrates and nitrites in food additives used in meat products.] [Lecture]

Berger, J. A.; Durand, P.; Frouin, A.; Courtet, A. M.; Petit, J.

Annales de la Nutrition et de l'Alimentation 34 (5/6)
883-891 (1980) [many ref. Fr, en] [Fac. de Pharmacie et
Inst. de la Viande, BP 38, 63001 Clermont Ferrand
Cedex, France]

Detailed analytical study of 52 commercial 'reddening salts' used for cured meat products revealed that the detn. of NO_3^- and NO_2^- by the official French method (AFNOR Nos. 04 409 and 04 410) suffered from interferences by colorants, ascorbic acid, proteins, spices and flavours. The great variations in results and difficulties in analysis were due to the complexity of the mixtures and to the lack of accurate information on their composition (although required by current legislation). The presence and concn. of the 10 main components of the 52 preparations analysed are tabulated. (See FSTA (1982) 14 3A149.) RM

21

[Effect of mercuric chloride on determination of nitrite in cured meat products.] [Lecture]

Bousset, J.

Annales de la Nutrition et de l'Alimentation 34 (5/6)
893-900 (1980) [7 ref. Fr, en] [Lab. de Recherches sur la
Viande, INRA, 78350 Jouey-en-Josas, France]

Effect of HgCl_2 on NO_2^- detn. was studied. 0.184-184 mmol/l were added during clarification or at the time of analysis with an autoanalyser. HgCl_2 was added to salami, bacon, dry sausage during ripening, and to cooked ham. An effect was noted only when HgCl_2 was

added at clarification. After cold water extraction, increased HgCl_2 addition increased the titratable NO_2^- . After hot extraction with water and borate, the effect of HgCl_2 was weaker but significant. Effect of HgCl_2 on NO_2^- detn. increased during ripening: it was weak in 16 h-old dry sausage (+ 40%), but became considerable after 2 wk (+ 600%). Use of HgCl_2 at 4 mmol/l for the detn. of total NO_2^- is recommended. Free NO_2^- should be analysed separately without HgCl_2 . [See FSTA (1982) 14 3A149.] AS

22

[Effect of storage conditions and sample treatment on 'free nitrite' in meat products.] [Lecture]
Rougie, P.; Noel, P.; Goutefongea, R.

Annales de la Nutrition et de l'Alimentation 34 (5/6) 1009-1017 (1980) [many ref. Fr, en] [Sta. de Recherches sur la Viande, INRA, Theix, 63110 Beaumont, France]

Effects of 2 different factors on the 'free nitrite' determined in meat products were studied. These were factors affecting (i) the amount of 'free' nitrite in the product, and (ii) the amount of nitrite determined as 'free'. Analysis of solutions (brine, standard NO_2^- solutions) and Paris ham showed that (i) is mainly dependent on storage conditions and that low pH, exposure to light and high temp. increase NO_2^- losses, while (ii) is dependent on methods of analysis: severe mechanical treatment of samples, high temp., prolonged and repeated extraction increase the amount of NO_2^- determined as 'free' by releasing part of the bound fraction. The validity of 'free' nitrite detn. can therefore be assessed only if the conditions of storage and sample preparation are accurately defined. [See FSTA (1982) 14 3A149.] AS

23

[The problem of additives in meat products: nitrites.]
Baldini, P.

Industria Conserve 56 (1) 26-32 (1981) [51 ref. It, en] [Sta. Sperimentale per l'Ind. delle Conserve Alimentari, Parma, Italy]

The conflicting demands of microbiological safety (especially with regard to *Clostridium botulinum*) and min. nitrosamine contents in meat products are reviewed. Effects of substrate (polarity, energy sources, catalysts, inhibitors, water activity, pH) and of processing techniques and storage conditions are discussed. RM

24

[Methods for determination of nitrites and nitrates, applicable to meat products.]

Bousset, J.

Annales de Technologie Agricole 29 (3) 415-436 (1980) [52 ref. Fr, en] [INRA. Lab. de Recherches sur la Viande, Cent. de Recherches Zootech., 78350 Jouy-en-Josas, France]

2 spectrophotometric methods, one manual and one automatic, for detn. of nitrate and nitrite in meat products are described. Nitrites are determined manually using sulphanilic acid and *N*-1-naphthylethylenediamine (extinction measurement at 530 nm), or automatically using sulphanilamide and *N*-1-naphthylethylenediamine (extinction measurement of 540 nm). Nitrates are extracted from the sample with 0.05N HCl; for manual analysis, the extracts are purified

on anion exchange resin; for automatic analysis, they are purified by continuous dialysis. Nitrate is then reduced to nitrite on Cd/Hg amalgam (manual method) or Cd/Cu alloy (automatic method), the resulting nitrite then being determined as above. Tables and graphs of experimental data showing the performance of the method are given. For the manual method, detection limit was 2.5 mg NaNO_2/kg and 5 mg KNO_3/kg ; accuracies were 2% and 7% resp. For the automatic method, detection limit was approx. 1 mg/kg for either NaNO_2 or KNO_3 , with accuracy better than 2%. AJDW

25

[Formation of NO_2 during maturation of dry salami.]
Simonetti, P.; Cantoni, C.; Dorigo, E.

Industria Alimentari 20 (2) 99-100 (1981) [11 ref. It] [Istituto di Ispezione degli Alimenti di Origine Anim., Fac. di Med. Vet., Univ. degli Studi, Milan, Italy]

The method of Bourbon et al. [*Pollution atmosferique* (1976) 69, 11] was used to determine presence of NO_2 in ripening Varzi type salami treated with KNO_3 (addition of up to 250 p.p.m. permitted by Italian law) and held at 11-13°C. The KNO_3 was determined daily for 10 days, as were total bacteria, micrococci and NO_2 . Results (tabulated and in graph form) showed that NO_2 production proceeded normally, the added nitrate being reduced by action of micrococci which grew quickly from an initial level of 4×10^4 to $1.7 \times 10^9/\text{g}$ on day 2, and then fluctuating during the next 7 days, reached $1.2 \times 10^8/\text{g}$ on day 10. Production of NO_2 (mg/kg) was 3.00 on day 1, increased to 35.40 on day 2, and thereafter decreased to 5.70 on day 10. KME

26

An investigation into the formation of *N*-nitrosamines in heated chicken frankfurters.

Gray, J. I.; Bussey, D. M.; Dawson, L. E.; Price, J. F.; Stevenson, K. E.; Owens, J. L.; Robach, M. C.

Journal of Food Science 46 (6) 1817-1819 (1981) [En] [Dep. of Food Sci. & Human Nutr., Michigan State Univ., E. Lansing, Michigan 48824, USA]

Chicken frankfurters, prepared with various levels of sodium nitrite (0, 20, 40, 60, 100, and 156 p.p.m.) were heated either in a microwave oven, boiled or broiled and then analysed for *N*-nitrosamines. As expected, "apparent" *N*-nitrosamine levels increased with increasing concn. of sodium nitrite. The effect of the various heating procedures on *N*-nitrosamine formation was inconclusive, due possibly to the low levels of "apparent" *N*-nitrosamines present. The 2 most common *N*-nitrosamines present appeared to be *N*-nitrosodimethylamine and *N*-nitrosomorpholine. However, only in the frankfurter samples prepared with 156 p.p.m. nitrite was the presence of *N*-nitrosomorpholine confirmed by MS. IFT

27

Long-chain acetals of ascorbic and erythorbic acids as antinitrosamine agents for bacon.

Bharucha, K. R.; Cross, C. K.; Rubin, L. J.

Journal of Agricultural and Food Chemistry 28 (6) 1274-1281 (1980) [10 ref. En] [Canada Packers Inc., Toronto, Ontario, Canada M6N 1K4]

In a previously published study [see FSTA 11 9S1399], various compounds were synthesized and subsequently found to inhibit nitrosamine formation in bacon. This paper continued this study by examining

one such class of compounds, viz. hitherto unknown long-chain acetals of ascorbic acid (AA) and erythorbic acid (EA). The bacon used in the study was commercial pump-cured side bacon (150 p.p.m. NaNO_2). Ascorbyl pivalate and ascorbyl acetone were applied to bacon slices in water solution because of their poor oil solubility. The acetone was also applied as a slurry in soybean oil. Ascorbyl palmitate and the acetals were applied as a slurry in antioxidant-free soybean oil (usually 4 ml/lb). The bacon was either fried immediately or vacuum-sealed in packages for storage at 3°C. Studies conducted on the bacon included: effect of storage time on anti-nitrosamine activity (ANA) of ascorbyl palmitate; influence of length of acetal side-chain on ANA; influence of sodium erythorbate on ANA of the C acetal of AA, effect of storage time on the ANA of acetals of hexadecanal with AA and EA at 1000 p.p.m.; effect of C16 acetal of AA on nitrosamine formation in bacon under household frying conditions; effect of adding acetal to the frying pan before the bacon on the nitrosamine level in fried bacon; and comparison of the effect of smoking and not smoking on nitrosamine levels in fried bacon. Results are detailed in tables and discussed. Conclusions included the following: ascorbyl palmitate is far more effective (70–90% inhibition at the 500–1000 p.p.m. level) than sodium ascorbate or erythorbate in reducing nitrosamine formation in bacon but its activity decreases with storage time; long-chain acetals of AA result in 93–98% reduction of nitrosamines in cook-out fat when streaked on bacon slices at 1000 p.p.m. C16 ascorbyl acetal (250 p.p.m.) either with or without sodium erythorbate (550 p.p.m.) gives 80–90% reduction of nitrosamine formation in cook-out fat; under household frying conditions, C16 ascorbyl acetal-treated bacon gives <1 part/billion nitrosamines; mode of application of acetal is not critical; C16 acetals of both AA and EA retain their activities (>90% inhibition of nitrosamines) for ≥ 35 days at 3°C when applied at the 100 p.p.m. level; smoking has little if any effect on nitrosamine levels in cooked bacon. JA

28

Stability of precured beef blends.

Ockerman, H. W.; Leon Crespo, F.

Journal of Food Science 46 (6) 1944–1945 (1981) [En]
[Ohio State Univ., Columbus, Ohio 43210, USA]

Preblends of lean beef were prepared using 20% water, 75 p.p.m. nitrite, 3 or 6 % salt (based on raw meat wt.) and stored at -10° , 0° and 15°C for 3 days. The nitrite levels in preblends were drastically reduced at 15°C , but, after the initial loss following nitrite addition, the residual nitrite remained almost unchanged for products stored at 0° and -10°C . Samples stored at 15°C increased in microbial numbers during storage and neither 3% nor 6% salt prevented this increase. Samples at both salt levels stored at 0° or -10°C did not show a significant change in bacterial numbers during storage. Salt and storage temp. had a significant effect on thiobarbituric acid (TBA) values, with 6% salt resulting in higher TBA values than 3% salt and storage at 15°C resulting in higher TBA values than storage at 0° or -10°C . IFT

29

[Nitrate, nitrite and nitrosamines in food.]

[Conference proceedings]

Sweden, SIK – Svenska Livsmedelsinstitutet

SIK Rapport No. 485, 150pp. (1980) [Sv, En, Da, No]

[Fack, S-400 23 Göteborg, Sweden]

This publication comprises papers presented at this symposium, held at SIK on 6–7 May 1980, including the following. Nitrates, nitrites and nitrosamines in foods, by J. Kahl (4pp., Sv). Analysis of nitrate and nitrite in foods, by B. Hedlund (9pp., Sv). Analysis of N-nitroso compounds in foods, by E. Josefsson (9pp., 9 ref., Sv). Occurrence of nitrate/nitrite in vegetables, by T. Nilsson (12pp., 8 ref., Sv). Summarizing report of the working party for study of occurrence of nitrosamines, by C.-E. Borström (26pp., 345 ref., Sv). Occurrence of nitrate and nitrite in dairy products, by B. Lindqvist (12pp., Sv). Occurrence of nitrate and nitrite in fish, by B. G. Snygg (9pp., Sv). Volatile N-nitroso compounds in foods in Sweden, by E. Josefsson & S. Nygren (22pp., 16 ref., Sv). Bacteriological aspects of the use of nitrite in meat products and alternatives for nitrite, by P. S. van Roon (13pp., 40 ref., En). Nitrate, nitrite and nitrosamines in foods. Improved process hygiene as an alternative to nitrite, by N. Skovgaard (22pp., 37 ref., Da). Colour of meat products, theory and possibilities for influencing it by E. Slinde (10pp., No). Norwegian experience with prohibition of nitrites, by H. K. Dahle (2 pp., No). AJDW

30

[Mutagenic activity of and nitroso compounds in meat and vegetable extracts.]

Porrini, M.; Testolin, G.; Cantoni, C.; Renon, P.

Industria Alimentari 20 (3) 174–176 (1981) [12 ref. It, en] [Istituto di Ispezione degli Alimenti di Origine Anim., Univ. degli Studi, Milan, Italy]

Experiments to ascertain presence of nitroso compounds in meat and bouillon cubes were carried out on 4 samples of meat and 3 of vegetable extracts. The method of Mirna et al. [see FSTA (1973) 5 11S 1328] was used to determine nitrates (absent in 5 samples, 19 and 27 mg/kg in the other 2) and nitrites (ranges, 318–421 mg/kg in the meat; 151–450 mg/kg in the vegetable extracts). N-nitrosamines were extracted, followed by analysis by either (i) spectrophotometry or (ii) gas chromatography. As (i) gave N-nitrosamine concn. $2\text{--}3 \times$ greater than (ii), 2 hypotheses are propounded in explanation, viz. the irradiation necessary in (i) may form reaction compounds which increase the absorbency, or the solvent (aqueous dichloromethane) used for (ii) may only partially extract the N-nitrosamines. Nitrosodimethylamine was detected in all samples (meat, 110, 70, 53 and 90 parts/billion (p.p.b.); vegetable extracts, 110 and 140 p.p.b.); traces of nitrosodiethylamine were found in only 1 sample. It is concluded that nitrates may induce mutagenic activity by their transformation to nitrosamines. KME

31

Effects of nitrite and sorbate on bacterial populations in frankfurters and thuringer cervelat.

Hallerbach, C. M.; Potter, N. N.

Journal of Food Protection 44 (5) 341–346, 352 (1981) [33 ref. En] [Dep. of Food Sci., Cornell Univ., Ithaca, New York 14853, USA]

4 batches of frankfurter emulsion were prepared with no additives; 0.26% potassium sorbate; 140 p.p.m. of NaNO_2 + 550 p.p.m. of sodium isoascorbate; and 40 p.p.m. + 0.26% potassium sorbate + 550 p.p.m. sodium isoascorbate, and processed. 5 batches of thuringer cervelat emulsion were prepared with no additives; 0.26% potassium sorbate; 156 p.p.m. of NaNO_2 ; 78 p.p.m. of NaNO_2 + 0.26% potassium sorbate; and 78 p.p.m. of NaNO_2 + 156 p.p.m. of NaNO_3 , and processed. The finished products were stored aerobically and bacterial growth patterns were monitored. At 20°C, presence of NaNO_2 and potassium sorbate, separately or together, in the frankfurters did not have an appreciable effect on total aerobic, total anaerobic, gram-positive, and *Lactobacillus-Pediococcus* counts, although at 7–9°C these additives moderately lowered bacterial counts. Bacterial counts of the thuringer cervelat were not affected by NaNO_2 , potassium sorbate or NaNO_3 at either temp. *Staphylococcus aureus* and *Clostridium perfringens* were inoculated into all emulsions before further processing to determine if the modified cures, or possible changes in normal microflora, influenced these pathogens. *S. aureus* was reduced to below detectable levels after heat-processing in all systems. *C. perfringens* survived processing and then underwent equally slow death in all stored frankfurter emulsions, and stabilization of counts in thuringer cervelat emulsions. Results indicate that the modified cures did not appreciably alter the natural microflora of these products, nor survival of added pathogens. AS

32

Review of the potential hazard from botulism in cured meats. [Review]

Holley, R. A.

Canadian Institute of Food Science and Technology Journal 14 (3) 183–195 (1981) [122 ref. En, fr] [Food Res. Inst., Agric. Canada, Ottawa, Ontario K1A 0C6, Canada]

The degree of hazard presented by *Clostridium botulinum* as a result of cured meat production at decreased or non-inhibitory concn. of nitrite is strongly influenced by the number of contaminating spores present, pH, salt concn. and water activity of the meat as well as the length and temp. of storage. Available information indicates that *C. botulinum* spores and vegetative cells occur in raw and processed meats with low frequency (0.04–2.18/kg.) Nitrite appears to inhibit *C. botulinum* spore outgrowth by interfering with some essential Fe-containing compound such as ferredoxin, which impairs energy yielding reactions. Synergistic reactions of nitrite with ascorbate, EDTA, sorbate and acidification are discussed as well as blocking reactions of nitrite action by Fe and reversal of this reaction by polyphosphate. While it appears that the use of sorbic acid as an adjunct to nitrite causes inhibition of *C. botulinum* in cooked bacon produced in N. America, there appears to be little enthusiasm for its use in uncooked bacon or pasteurized cured meats in Europe, due in part to uncertainty regarding the toxicity of its reaction products and poor performance against clostridia. Biological acidification of bacon by starter cultures is a promising alternative for the production of

safe, low-nitrite bacon. Nisin may prove to be of some value in decreasing the heat process or nitrite concn. required for production of semi-preserved meats. The need for use of lowered nitrite concn. because of nitrosamine formation is discussed for major product categories. Specific problem areas are identified and some suggestions for future research are made. AS

33

Bringing home the (nitrite-less) bacon.

Glick, N.

FDA Consumer 13 (4) 25–26 (1979) [En]

The possibility of existing in a nitrite-less world should nitrite be confirmed as a cause of cancer is considered. The necessity to protect against botulinal contamination is stressed. The special care required in handling the nitrite-free products which are now being marketed is considered. VJG

34

[Studies on changes in residual nitrite in meat products during storage.]

Shin, K. W.; Cho, J.; Namkung, S.; Whang, D. W.

Korean Journal of Veterinary Public Health 3 (1) 9–13 (1979) [9 ref. Ko, en] [Dep. of Nutr., Seoul Health Junior Coll., S. Korea]

Studies were conducted on changes in residual nitrite contents of samples of sausage and of ham stored for ≤ 30 days at either 5° or 30°C. Residual nitrite concn. (as % of the initial value) of sausages stored at 5°C decreased to a min. of 23.90% after 8 days, then increased to a max. of 87.33% after 24 days, then decreased again to 33.71% after 30 days. Values for hams stored at 5°C decreased to a min. of 15.89% after 8 days, increased to a max. of 70.21 after 24 days, decreased to 34.10% after 28 days, and increased to 53.68% after 30 days. Values for sausages stored at 30°C decreased to a min. of 12.21% at 8 days, and increased to a max. of 77.67% at 30 days. Values for ham stored at 30°C decreased to a min. of 12.42% at 8 days, remained low up to day 26, then increased to a max. of 26.93% on day 30. [From En summ & tables.] AJDW

35

[Colour formation in 'combined' boiled sausages containing milk co-precipitate.]

Zhuravskaya, N. K.; Perkel', T. P.

Izvestiya Vysshikh Uchebnykh Zavedenii, Pishchevaya Tekhnologiya No. 1, 38–40 (1981) [6 ref. Ru] [Moskovskii Tekh. Inst. Myasnoi i Molochnoi Promyshlennosti, Moscow, USSR]

Colour of 'combined' boiled sausage was determined, and the contents of nitrosopigments and residual nitrite as affected by the degree of substitution of meat by milk coprecipitate, pH of the basic raw material and ascorbic acid content. Addition of milk coprecipitate increased pH, reduced the content of nitrosopigments and increased the residual content of nitrites in the finished product. Addition of ascorbic acid increased content of nitrosopigments and reduced the content of nitrite. STI

36

High-performance liquid chromatographic determination of nitrite in environmental samples by the use of hydralazine.

Noda, H.; Minemoto, M.; Asahara, T.; Noda, A.;

Iguchi, S.

Journal of Chromatography 235 (1) 187-195 (1982)

[19 ref. En] [Dep. of Hospital Pharmacy, Univ. of Occupational & Environmental Health, 1-1 Iseigaoka, Yahatanishi-ku, Kitakyushu 807, Japan]

A HPLC procedure with UV and fluorometric detectors has been developed for detn. of nitrite by use of hydralazine. Hydralazine reacts with nitrite ion under acidic conditions at 37°C to form tetrazolo[5,1-a]phthalazine (Tetra-P) almost quantitatively. Without extraction, the detn. of Tetra-P by reversed-phase HPLC was simple, specific, sensitive and reliable over the range 0.001-0.10 p.p.m. of nitrite N. This procedure using hydralazine is one of the most useful methods for routine analysis of nitrites in foods, biological fluids and ambient waters. AS

37

[Nitrate, nitrite and nitrosamines - consumption and health hazards.]

Slorach, S. A.

Var Föda 33 (8/9) 324-334 (1981) [11 ref. Sv]

[Toxikologiska Lab., Statens Livsmedelsverk, 751 26 Uppsala, Sweden]

Aspects discussed include: sources of nitrate and nitrite in the diet (natural sources and use as additives); intake of nitrate and nitrite in the diet; formation of nitrite and nitrate in the body; toxicity of nitrates and nitrites, and the health hazard therefrom; minimization of risks; N-nitroso compounds and their sources (including cured meat products and beer); formation in the body; carcinogenicity, and minimization of health hazards. AJDW

38

A note on the effect of nitrite inhibition on the metabolism of *Clostridium botulinum*.

Woods, L. F. J.; Wood, J. M.

Journal of Applied Bacteriology 52 (1) 109-110 (1982)

[9 ref. En] [Microbiol. Sect., Leatherhead Food Res. Ass., Randalls Road, Leatherhead, Surrey KT22 7RY, UK]

Inhibition of the phosphoroclastic system of different types of *Clostridium botulinum* by sodium nitrite resulted in an accumulation of pyruvic acid in the medium. AS

39

[Nitrite and nitrate. New regulations on permitted use of these additives in foods.] Nitrit und Nitrat. Neugefasste Verordnung über die Zulassung dieser Stoffe in Lebensmitteln.

Bertling, L.

GV-Praxis mit Tiefkühlpraxis 21 (5) 38, 40 (1981) [De]

[Chem. Untersuchungsinst., Wuppertal/Solingen, Federal Republic of Germany]

The new regulations for Nitrite and Nitrate in Foods,

which came into force on 31 Dec. 1980, are briefly discussed. Aspects considered include: nitrites in relation to nitrosamine formation; methaemoglobinaemia; nitrite and nitrate in the environment and as a natural component of foods; restrictions on addition of nitrate and nitrite to foods; reduction of the nitrite content of nitrite curing salt; prohibition of addition of KNO₃ to spices or seasoning mixtures; prohibition of use of nitrite or nitrate in various meat products; and practical implications of these regulations for the meat processing industry. AJDW

40

Sensory attributes and Instron measurements of reduced-nitrite poultry frankfurters with sorbic acid or potassium sorbate.

Chambers, E. IV; Bowers, J. A.; Prusa, K.; Craig, J.

Journal of Food Science 47 (1) 207-209 (1982) [En]

[Dep. of Foods & Nutr., Kansas State Univ., Manhattan, Kansas 66506, USA]

Poultry frankfurters (0 and 40 p.p.m. nitrite) with sorbic acid or potassium sorbate were studied. Flavour characteristics were influenced by nitrite but not by ascorbic acid or potassium sorbate. Frankfurters with sorbic acid were softer, and those with potassium sorbate were firmer than those without. Nitrite alone increased firmness. Sorbic acid appeared to counteract that increased firmness, and potassium sorbate enhanced the increase in firmness when those compounds were used in combination with nitrite in the poultry frankfurters. Simulated-teeth attachments for the Instron gave results similar to sensory firmness scores. Frankfurters with sorbic acid added had lower pH than frankfurters from other treatments. IFT

41

Effect of belly composition on sorbate-cured bacon.

Amundson, C. M.; Sebranek, J. G.; Rust, R. E.;

Kraft, A. A.; Wagner, M. K.; Robach, M. C.

Journal of Food Science 47 (1) 218-221 (1982) [En]

[Dep. of Anim. Sci., 215 Meat Lab., Iowa State Univ., Ames, Iowa 50011, USA]

A comparison was made between fat-type and lean-type bellies cured with either 40 p.p.m. sodium nitrite/0.26% potassium sorbate or 120 p.p.m. sodium nitrite. Residual nitrite levels were higher in fat bacon regardless of cure. Sorbate-cured bacon resulted in significantly higher thiobarbituric acid numbers than did regular-cure bacon. Nitrosopigment:total pigment ratio did not vary with cure, but did remain significantly higher in fat bacon and roughly paralleled residual nitrite levels. Analysis for nitrosamines indicated greater concn. in fat bellies compared to lean. Nitrosamines were suppressed though not eliminated, by the sorbate cure in both fat and lean bellies. IFT

42

Effect of belly handling (chilled, frozen, pre-rigor) and smoking delay on regular and sorbate cured bacon.

Amundson, C. M.; Sebranek, J. G.; Kraft, A. A.; Rust, R. E.; Wagner, M. K.; Robach, M. C. *Journal of Food Science* 47 (1) 222-225 (1982) [En] [Dep. of Anim. Sci., 215 Meat Lab., Iowa State Univ., Ames, Iowa 50011, USA]

Bellies from 3 handling methods; fresh, frozen, or prerigor were cured with either 40 p.p.m. sodium nitrite/0.26% potassium sorbate or 120 p.p.m. sodium nitrite. After pumping, one group of bellies was processed (cooked and smoked) immediately, and the remaining group was held 72 h before processing. Residual nitrite was significantly higher in regular cure bacon and in bellies processed immediately. By 28 days after packaging, little difference was seen in residual nitrite as a result of any treatment. Regular bacon and immediate processing resulted in greater nitrosopigment conversion. Prerigor bacon had greater pigment conversion and greater residual NaCl concn. while fresh and frozen bellies were similar. Nitrosamine levels were not influenced by belly handling variables. IFT

43

[Determination of nitrates and nitrites in meat.]

Pallotti, G.; Corsolino, A.

Bollettino dei Chimici dei Laboratori Provinciali 32 (S4) 199-217 (1981) [125 ref. It, fr, en, de] [Lab. Chimico di Igiene & Profilassi di Roma, Rome, Italy]

Tabulated data are presented on NO_3^- and NO_2^- contents in 1409 meat products (ham, sausages). Mean values were 61 mg/kg NO_3^- , 17 mg/kg NO_2^- . The authors suggest that legal limits be expressed as anions and refer to residues, not amounts used. Uniform methods are recommended for sampling, sample preparation, extraction, clean-up and clarification. Current methods are initially examined. Based on analysis of 260 samples of uncured pork, 15 mg NO_3^- /kg should be subtracted from the results of analysis (as meat blank). Alternative methods for preserving meat products are briefly discussed. RM

44

[Sodium nitrite and bacterial inhibition.]

Cantoni, C.; Bersani, C.; Bianchi Paleari, M. A.; Beretta, G.

Industria Alimentari 20 (7/8) 514-516 (1981) [22 ref. It] [Istituto di Ispezione degli Alimenti di Origine Anim., Univ. degli Studi di Milano, Milan, Italy]

In research on the inhibitory action of NaNO_2 on *Salmonella typhimurium* and *Clostridium perfringens* by ascertaining the development of cultures in presence of 100-2000 $\mu\text{g/ml}$ NaNO_2 at pH 7.1 and 5.4, the more acidic substrate increased the inhibitory effect on *S. typhimurium*, but the clostridia were inhibited on both substrates. In a further series of tests on the interaction between the salt and cellular SH-groups of *Escherichia coli*, *Micrococcus* spp. and *Cl. perfringens* (after 12 h contact of 5 g cells of each with 100 mg NaNO_2 at pH 5.2 and 7.2), the SH-groups declined in every instance. It is believed that the reaction results from nitrite interference in the cell metabolism after penetration by the NO_2^- ion. Further study is recommended. KMF

45

Depletion of sodium nitrite by lactic acid bacteria isolated from vacuum-packed bologna.

Collins-Thompson, D. L.; Rodriguez Lopez, G. *Journal of Food Protection* 44 (8) 593-595 (1981) [15 ref. En] [Dep. of Environmental Biol., Univ. of Guelph, Guelph, Ontario N1G 2W1, Canada]

Cultures of lactic acid bacteria isolated from commercial samples of vacuum-packed bologna were used in the studies, the bacteria being identified as *Leuconostoc mesenteroides*, *Lactobacillus plantarum*, *Lactobacillus viridescens*, *Lactobacillus brevis* and *Brochothrix thermosphacta*. Preliminary studies involved detn. of the degree of microbial depletion of nitrite by these bacteria, under anaerobic conditions in APT broth containing NaNO_2 and incubated at 5° or 15°C; the degree of non-microbial depletion of nitrite was also determined. The greatest reduction of nitrite was observed with *L. mesenteroides*, followed by *L. plantarum* and *L. viridescens*, while both *L. brevis* and *B. thermosphacta* showed nitrite depletion similar to that in uninoculated broth; in all cases, nitrite depletion was much greater at 15°C than at 5°C. Further studies examined nitrite depletion by the lactic acid bacteria in non-irradiated and irradiated (0.3 Mrad) samples of vacuum-packed bologna stored at 5°C for 4 wk after inoculation with the bacteria. Some nitrite was found to be lost as a result of irradiation. The level of nitrite depletion by the individual bacteria was similar to that in the broth, with *L. mesenteroides* producing the greatest reduction and *L. brevis* and *B. thermosphacta* the smallest. JA

46

[Proteolysis during storage at 22°C after γ -irradiation of muscle from axenic animals (*Rattus rattus*) with or without addition of nitrates or nitrites.]

Bousset, J.

Annales de Technologie Agricole 29 (3) 437-446 (1980) [17 ref. Fr, en] [INRA, Lab. de Recherche sur la viande, Cent. de Recherches Zootech., 78350 Jouy-en-Josas, France]

Model studies using axenic rat muscle were conducted to evaluate enzymic proteolysis in samples irradiated at 10, 30 or 50 Gy, and stored at 22°C. Irradiation increased soluble N (as % of total N) but had little effect on % non-trichloroacetic acid (TCA) precipitable N concn. During storage for 4 wk, both soluble N and non-TCA-precipitable N concn. increased, irrespective of irradiation. Addition of 150 or 300 p.p.m. nitrate or nitrite had no effect on proteolysis. It is concluded that γ -irradiation at ≤ 50 Gy has little effect on enzymic proteolysis in meat; hence heat treatment should be included, to eliminate proteases, in meat irradiation processes. AJDW

47

The inhibition of bacterial spore germination by potassium-sorbate and sodium-nitrite.

Smoot, L. A.

Dissertation Abstracts International, B 42 (3) 955-956: Order no. 8118714, 284pp. (1981) [En] [Virginia Polytech. Inst. & State Univ., Blacksburg, Virginia 24061, USA]

Beef and beef-pork frankfurters, formulated with various concn. of sorbic acid (SA), potassium sorbate (PS) and/or sodium nitrite (SN), were inoculated with *Clostridium botulinum* spores (a mixture of 4 type A and 5 type B strains), vacuum packaged and stored at

27° and 15°C. The stored frankfurters were examined for spore germination and botulinal toxin formation. Toxin was not detected in any frankfurter stored at 15°C. Other results included the following. At 27°C, beef frankfurters containing 2000 p.p.m. SA, 3000 p.p.m. SA, 2000 p.p.m. SA + 50 p.p.m. SN, 2600 p.p.m. PS, 3900 p.p.m. PS, or 2600 p.p.m. PS + 50 p.p.m. SN exhibited protection against toxin formation equal to that of frankfurters containing 156 p.p.m. SN. At 27°C, toxin formation in low salt (1.8% NaCl) beef-pork frankfurters was prevented only in the presence of 120 p.p.m. SN. A further study consisted of a series of experiments in which spores of *Bacillus cereus* T and *Cl. botulinum* 62A were germinated in various chemically defined media with or without PS, SN, crotonic acid or disodium maleate. PS was found to be a strong inhibitor of spore germination while the other 3 compounds were found to be weak inhibitors. JA

48

Determination of nitrate in meat products and cheeses by gas-liquid chromatography with electron-capture detection.

Tanaka, A.; Nose, N.; Iwasaki, H.

Journal of Chromatography 235 (1) 173-185 (1982) [22 ref. En] [Saitama Inst. of Public Health, Kamiokubo-Higashi, 639-1, Urawa, Saitama, Japan]

A simple, sensitive and practical method for detn. of nitrate in various meat products and cheeses is described. The method is based on the nitration of 2-sec-butylphenol in approx. 57% H₂SO₄ to form 4-nitro-2-sec-butylphenol. After nitration, the toluene extract is re-extracted with an alkaline solution and subsequently analysed by GLC with an electron-capture detector (GLC-ECD) using a column of OV-17 on Chromosorb W HP after pentafluorobenzoylation and extraction with n-hexane. The nitrate concn. is calculated from the peak height. Amounts of 0.05-1.0 µg nitrate can be determined; detection limit is 0.006 µg/ml. The procedure for determining nitrate in meat products and cheeses involves direct analysis by GLC-ECD without clean-up; the detection limit is 0.07 p.p.m. and the recovery from meat products and cheeses ranged from 96.8 to 99.0% at the 5 p.p.m. level and from 94.7 to 98.6% at the 10 p.p.m. level. The nitrated compound of 2-sec-butylphenol was identified as 4-nitro-2-sec-butylphenol by TLC and NMR spectroscopy and the final pentafluorobenzoylated product was confirmed by combined gas chromatography-MS. AS

49

The nitrite-cancer controversy.

Carr, C. J.

Regulatory Toxicology and Pharmacology 1 (1) 68-77 (1981) [12 ref. En] [Food Safety Council, 1725 K Street, NW, Suite 306, Washington, DC 20006, USA]

This report was prepared to illustrate the work of the Scientific Committee of the Food Safety Council on the nitrite-cancer controversy. Headings surveyed are: background, evidence of nitrite-nitrate hazard, FDA

actions, UAREP (Universities Associated for Research and Education in Pathology) contributions, test evaluations, different interpretations of pathology findings, conclusions of the interagency working group, other nitrite animal studies, present status of the controversy, the Food Safety Council report, and the safety decision tree (8 decision steps involved). LH

50

[Comparative determination of nitrite content in meat products by four conventional colorimetric methods and a quick test.] Vergleichende Bestimmung des Nitritgehaltes in Fleischerzeugnissen mittels vier kolorimetrischer Methoden und eines Schnelltests. Ostertag, K.; Kraft, G.; Fischer, A. *Archiv für Lebensmittelhygiene* 31 (2) 35-43 (1980) [36 ref. De, en] [Inst. für Lebensmitteltech., Univ. Hohenheim, Garbenstrasse 25, 7000 Stuttgart 70, Federal Republic of Germany]

4 conventional colorimetric methods and one quick method for NO₂-detn. in meat products were compared, i.e. (i) Gran/Mirua [*Zeitschrift für Analytische Chemie* (1957) 158, 182]; (ii) modified AOAC [FSTA (1977) 9 12S2052] (iii) Adriaanse/Robbers [*Journal of the Science of Food and Agriculture* (1969) 20, 321]; (iv) Fudge & Truman [FSTA (1973) 5 11S1326]; (v) the Aquaquant quick test [FSTA (1979) 11 5S794]. Finely and coarsely minced Brühwurst and Salami were analysed, and results are shown graphically and in tables. Methods (i) and (iv) gave similar results, method (v) slightly higher NO₂-concn.; results by methods (ii) and (iii) were dependent on the product and storage time. Method (iv) was recommended for routine application, method (v) for process control (time required 140-200 min and 10 min resp.) RM

51

Effect of nitrite content and smoking on yield, shelf-life, and palatability of Cornish game hens.

Goodwin, T. L.; Ikeme, A. I.

Poultry Science 60 (3) 679-682 (1981) [11 ref. En] [Dep. of Anim. Sci., Univ. of Arkansas, Fayetteville, Arkansas 72701, USA]

Effects of nitrite and smoking on yield and palatability of Cornish game hens were studied: carcasses were (i) injected, (ii) soaked or (iii) injected + soaked with 6.98% pickling brine before smoking. Cooking temp. was 46°C for 2 h, followed by smoking at 93°C for 5 h. Yield, nitrite content, NaCl content, rancidity development and palatability were evaluated. NaCl and nitrite contents were highest in (iii) samples. White meat appearance was better for (iii) than for (i) or (ii); dark meat appearance was better for (ii) than for (i) or (iii). Meat from (iii) was the juiciest. General acceptability and flavour were highest for (iii) white meat and (ii) dark meat. The treatments studied did not significantly influence rancidity or yield. AIDW

52

Use of nitrite and nitrite-sparing agents in meats: a review. [Review]

Marriott, N. G.; Lechowich, R. V.; Pierson, M. D. *Journal of Food Protection* 44 (11) 881-885 (1981) [54 ref. En] [Dep. of Food Sci. & Tech., Virginia Polytech. Inst. & State Univ., Blacksburg, Virginia 24061, USA]

Aspects considered include: historical aspects; nitrites in relation to nitrosamine formation; nitrites in relation to inhibition of *Clostridium botulinum*; and agents and processes possibly permitting use of lower nitrite levels (with reference to sorbic acid, acid-forming starter cultures, n-alkyl *p*-hydroxybenzoic acid esters, ascorbate, isoascorbate, and antioxidants). AJDW

53

[Bacteriological and sensory tests on dry sausages with reduced levels of nitrite.] Bakteriologische und sensorische Untersuchungen von Rohwürsten mit verringertem Nitritzusatz.

Gerigk, K.; Gossling, U.

Fleischwirtschaft 61 (8) 1124-1128; 1170 (1981) [many ref. De, en] [Inst. für Veterinärmedizin (Robert von Ostertag-Institut) des Bundesgesundheitsamtes, Thielallee 88-92, D-1000 Berlin 33]

The effects of reducing NO_2 -addition to dry sausages on microbiological and sensory quality were investigated. Mixtures were prepared with 28 g/kg nitrite curing salt (144 mg NaNO_2 /kg, control), and 16.8 g/kg curing salt (88 mg NaNO_2 /kg) resp., and the microflora was examined after maturing for 2, 6, 10 and 15 days. Tabulated results showed no noticeable differences in the development of the microflora, or chemical changes: at either NO_2 -level, pH dropped to 4.8-4.9, NO_2^- and NO_3^- levels fell during maturing. Residual NO_2^- fell to < 10 mg/kg after 4 days, irrespective of the amount added, residual NO_2^- concn. fell to levels proportional to the added NO_2^- . After 15 days' ripening, residual $\text{NO}_2^-/\text{NO}_3^-$ level was 34% lower in products with reduced NO_2^- addition. No differences were observed in sensory evaluation (Karlsruhe 9-point scale), especially with regard to colour and flavour. RM

54

Interaction between sample preparation techniques and colorimetric reagents in nitrite analysis in meat.

Fox, J. B.; Zell, T. E.; Wasserman, A. E.

Journal of the Association of Official Analytical Chemists 64 (6) 1397-1402 (1981) [14 ref. En] [Eastern Reg. Res. Cent., USDA, Philadelphia, Pennsylvania 19118, USA]

The amount of nitrite measured in model and meat systems was a function of the interactions of chloride and ascorbate concn. with the method of sample preparation and the combination of Griess reagents used for colorimetric detn. Ascorbate caused loss of nitrite in the samples when heated and interfered in the Griess reaction, increasing the concn. of pigment formed from any given concn. of nitrite if sulphanilic acid and *N*-(1-naphthyl)-ethylenediamine were used,

and decreasing the amount if sulphanilamide and 1-naphthylamine were used. The interference was eliminated by both the AOAC procedure and mercuric chloride addition, although the former were less effective at higher ascorbate concn. Chloride increased the amount of pigment formed from a given amount of nitrite with sulphanilic acid but had no effect on the amount of sulphanilamide pigment. AS

55

Effects of nitrosamines, nitrite and secondary amines on tumor development in mice. [Lecture]

Pearson, A. M.; Sleight, S. D.; Cornforth, D. P.; Akoso, B. T.

Proceedings of the European Meeting of Meat Research Workers No. 26, Vol. II, M-2, pp. 216-218 (1980) [5 ref. En] [Michigan State Univ., E. Lansing, Michigan 48824, USA]

Trials were conducted with mice receiving (i) control tap water, (ii) water containing *N*-nitrosopyrrolidone at 100 mg/l; (iii) water containing 1 g NaNO_2 /l, or (iv) water with 100 mg NaNO_2 /l + 100 mg pyrrolidine/l, for 12 months. 10 mice received each treatment. The study was replicated 4 times. Data are given for feed and water consumption, survival and incidence of cancers. Survival ranged from 94.4% for (i) to 80.5% for (ii), differences approached significance. Group (ii) had a much higher incidence of tumours of the lungs and liver than the other groups; incidence of tumours did not differ significantly between (i), (iii) and (iv). The results are considered in relation to the lack of carcinogenicity of diet (iv) (nitrite + secondary amine) and its implications for the postulated nitrosation of amines in the stomach. [See FSTA (1982) 14 8S1379.] AJDW

56

Effects of ascorbate and nitrite concentrations in turkey frankfurter-type products.

Tellefson, C. S.; Bowers, J. A.

Poultry Science 60 (3) 579-583 (1981) [14 ref. En] [Dep. of Food & Nutr., Kansas State Univ., Manhattan, Kansas 66506, USA]

Raw, cooked, and cooked-stored turkey frankfurter-type products with 0, 500, 1000, and 5000 p.p.m. sodium ascorbate and 0 and 60 p.p.m. sodium nitrite were analysed for total ascorbic acid (TAA) and malonaldehyde (MA) content. Colour of cooked products and consumption of raw emulsions were measured. With 5000 p.p.m. sodium ascorbate and 60 p.p.m. sodium nitrite, no differences in TAA content were found among the three types of frankfurter-type products. Storing cooked frankfurter-type products containing ascorbate usually resulted in lower TAA. Ascorbate tended to inhibit MA in cooked and cooked-stored frankfurter-type products. When nitrite and ascorbate were present, cooking and storing did not result in higher MA. With added nitrite, reddish cured meat colour generally increased as ascorbate concn. increased. Raw emulsions consumed O_2 more rapidly when no nitrite was added. AS

57

Effect of packaging film and vacuum level on regular and sorbate-cured bacon.

Amundson, C. M.; Sebranek, J. G.; Kraft, A. A.; Rust, R. E.; Wagner, M. K.; Gehrke, W. H.

Journal of Food Science 47 (2) 355-358, 362 (1982)

[En][Dep. of Anim. Sci., Iowa State Univ., 215D Meat Lab., Ames, Iowa 50011, USA]

Bacon was produced with either 40 p.p.m. NaNO_2 /0.26% potassium sorbate, or 120 p.p.m. NaNO_2 . Slices were packaged in either nylon/Surlin or nylon/Saran/Surlin pouches and sealed at either a high or intermediate vacuum level. At 0, 10, 21 and 28 days after packaging, residual nitrite, rancidity, pH, residual salt and pigment conversion were measured. Residual nitrite and pH were lower while nitrosopigment conversion was higher in bacon packaged with the high-barrier film. Vacuum level, however, had no effect on any measured characteristic. The sorbate/reduced nitrite cure resulted in lower pigment conversion, lower residual nitrite, and a higher thiobarbituric acid number. IFT

58

Effect of pork belly-type on the microbiology of bacon cured with or without potassium sorbate.

Wagner, M. K.; Kraft, A. A.; Sebranek, J. G.; Rust, R. E.; Amundson, C. M.

Journal of Food Protection 45 (1) 29-32, 37 (1982)

[20 ref. En][Dep. of Food Tech., Iowa State Univ., Ames, Iowa 50011, USA]

Fat- and lean-grade hog bellies were used to evaluate the microbiology of bacon cured with either 40 p.p.m. of nitrite + 0.26% of potassium sorbate or 120 p.p.m. of nitrite with no potassium sorbate. Bacon slices were inoculated to provide an initial representative flora of 10^5 - 10^6 organisms/g of meat. Bacon was packaged in high barrier film with high vacuum (28-29 in Hg), stored at 0-5°C, and analysed at 0, 10, 21 and 28 days after processing for enumeration and identification of mesophilic, psychrotrophic and lipolytic organisms. In general, the 40 p.p.m. of nitrite + 0.26% of potassium sorbate cure provided greater bacterial inhibition (especially in fat bacon) than did the nitrite cure.

Lactobacillus and *Bacillus* were the most common isolates characterized. AS

59

[Nitrites in sausages smoked in an "out house".]

Jarmund, T.

NINF Informasjon No. 1, 60-61 (1982)[No]

In this brief report of a case history, tests showed that sausages smoked in a traditional "out house" contained 15-40 mg nitrites/kg, vs. 0 in the raw sausage meat and 0 in samples treated by modern smoke generators.

Analysis showed that the alder wood used traditionally contained 4 x as much N as birch wood, and that the nitrite contents were attributable to use of the alder wood. HBr

60

SSP: meat products with minimal nitrite addition, storable without refrigeration. [Lecture]

Leistner, L.; Vukovic, I.; Dresel, J.

Proceedings of the European Meeting of Meat Research Workers No. 26, Vol. II, M-6, pp. 230-233

(1980)[10 ref. En][Federal Cent. for Meat Res., Kulmbach, Federal Republic of Germany]

Studies were conducted on microbiological characteristics of low-nitrite (50 p.p.m.) shelf-stable Mortadella and Brühdauerwurst sausages formulated to have $a_w < 0.950$. The sausages were inoculated with cultures of various spp. and strains of *Clostridium* and *Bacillus*; Brühdauerwurst was also inoculated with *Streptococcus faecium* + *Strep. faecalis*, and with *Aspergillus* and *Penicillium* spp. Counts of these organisms were determined at various stages of processing and storage. The products studied were microbiologically stable for ≥ 60 days at 25°C, provided a_w was ≤ 0.950 . In Mortadella, most *Bacillus* spp. did not multiply even at a_w 0.976. Cooking to an internal temp. of 75°C inactivated heat-resistant sporeforming *Streptococcus* sp. Moulds grew in inoculated Brühdauerwurst; 20% potassium sorbate dips prevented this. [See FSTA (1982) 14 8S1379.] AJDW

61

The microbiology of 'back bacon' manufactured in 'nitrate-free' brines after storage at 5°C. [Lecture]

Dempster, J. F.

Proceedings of the European Meeting of Meat Research Workers No. 26, Vol. II, N-6, pp. 272-275 (1980)[22 ref. En][An Foras Taluntais, Dunsinea Res. Cent., Castleknock, County Dublin, Irish Republic]

Wiltshire-style bacon was prepared using 3 brine compositions with (i) 2000 $\mu\text{g NaNO}_2/\text{g}$, no added nitrate; (ii) 500 $\mu\text{g NaNO}_2/\text{g}$, no added nitrate; (iii) 1000 $\mu\text{g NaNO}_2/\text{g}$ + 1000 $\mu\text{g NaNO}_3/\text{g}$. After brining and maturation, the sides of bacon were boned, sliced and vacuum-packaged. Samples were evaluated microbiologically after storage for up to 6 wk at 5°C. 140 isolates of Gram-positive, catalase-positive cocci were detected; 14% were coagulase-positive staphylococci; these died out during storage, none being detectable after 4 wk. The majority of micrococci were phosphatase-negative, and persisted throughout storage, predominating during the middle period. 118 isolates were Gram-positive or -negative rods; the majority (59%) were classified as heat-sensitive corynebacteria. These increased in importance during storage, reaching 50-60% of the total. Only 3% of isolates were *Brochothrix thermospacta*; 6 were identified as *Acinetobacter* spp., 12 as flavobacteria, and 2 as *Vibrio* spp. *Aeromonas* spp. comprised 13% of the Gram-negative rods, and were detected for the first 4 wk. 4 yeasts were detected. Counts of micrococci increased and counts of staphylococci and coryneforms decreased with increasing nitrite concn. [See FSTA (1982) 14 8S1379.] AJDW

62

Nitrosamines in irradiated bacon. [Lecture]
Fiddler, W.; Gates, R. A.; Pensabene, J. W.; Wierbicki, E.
Proceedings of the European Meeting of Meat Research Workers No. 26, Vol. I, E-19, pp. 237-240 (1980) [14 ref. En] [USDA, E. Reg. Res. Cent., Philadelphia, Pennsylvania 19118, USA]

Pork bellies were cured to give NaNO_2 concn. of 0, 20 or 120 p.p.m., smoked, sliced, packed in metal cans, γ -irradiated at -40°C with a dose of 3.0 Mrad, and subsequently analysed for residual nitrite; nitrosamines were determined in fried samples. Irradiation reduced the residual nitrite concn., and hence reduced levels of nitrosodimethylamine and nitrosopyrrolidone in the fried bacon. Levels of nitrosamines in samples cured with 20 p.p.m. nitrite were indistinguishable from those in the nitrite-free product. [See FSTA (1982) 14 8S1379.] AJDW

63

Changes in meat pigments as a result of radappertization. [Lecture]

Karel, M.; Kamarei, A. R.; Wierbicki, E.
Proceedings of the European Meeting of Meat Research Workers No. 26, Vol. I, E-15, pp. 221-224 (1980) [9 ref. En] [Massachusetts Inst. of Tech., Cambridge, Massachusetts, USA]

Studies were conducted to evaluate effects of irradiation on beef and pork myoglobin, metmyoglobin and nitrosomyoglobin, and on pigments in cured and non-cured meats. Effects of irradiation temp. are also considered. Data are presented showing effects of irradiation on reflectance spectra and on subjective colour scores. Irradiation of isolated pigments showed shifts in characteristic peaks and a progressive decrease in the Soret band (375-450 nm); this decrease was greater at 3°C than at -30° to -80°C . Reflectance of irradiated uncured beef decreased with time, whereas that of non-irradiated beef did not. Visual colour scores of non-nitrite cured samples were increased by irradiation, due to bright red colour formation; scores of nitrite-cured samples were decreased by irradiation. Nitrate did not play a role in such colour changes. Mechanisms of these effects of irradiation on pigments in and colour of meat products are briefly considered. [See FSTA (1982) 14 8S1379.] AJDW

64

Irradiated bacon without and with reduced addition of nitrite. [Lecture]

Wierbicki, E.; Heiligman, F.
Proceedings of the European Meeting of Meat Research Workers No. 26, Vol. I, E-9, pp. 198-201 (1980) [24 ref. En] [Food Eng. Lab., US Army Natick R&D Command, Natick, Massachusetts 01760, USA]

Samples of bacon made with added NaNO_2 concn. of 0, 20 or 120 p.p.m., and packaged in 1-lb units in a nylon/polyethylene/surlyn film, were electron irradiated at 2.2, 7.5 or 15 kGy, then stored at 5°C . Aerobic plate counts, TBA value, peroxide value, free fatty acid content and organoleptic properties were evaluated. Irradiation at 7.5 or 15 kGy eliminated spoilage

organisms and gave a shelf-stable product; lower doses extended shelf-life as compared to non-irradiated control samples. Irradiation had no effect on the colour of nitrite-cured bacon, but improved the colour of nitrite free bacon. Irradiation under vacuum had little effect on fat quality indices. Acceptability of the nitrite-free bacon was slightly lower than that of the nitrite-containing bacons; irradiation did not significantly impair acceptability of the bacon. Inoculated pack studies showed that 15 kGy irradiation of 0 or 20 p.p.m. NaNO_2 bacons gave safety from botulism equal to that achieved with 120 p.p.m. nitrite. [See FSTA (1982) 14 8S1379.] AJDW

65

Use of nitrite and sorbate for botulism control. [Lecture]

Sofos, J. N.; Busta, F. F.; Allen, C. E.
Proceedings of the European Meeting of Meat Research Workers No. 26, Vol. II, M-9, pp. 241-244 (1980) [20 ref. En] [Univ. of Minnesota, St. Paul, Minnesota, USA]

Studies were conducted on the efficacy of NaNO_2 (0, 20, 40, 80, 120 or 156 p.p.m.) and/or sorbic acid/sorbate (0, 0.10, 0.15 or 0.20%) for control of *Clostridium botulinum* in bacon or in comminuted substrates (mechanically-deboned chicken meat, beef, pork, soy protein products, or a beef-soy protein blend). The products studied were inoculated with heat-shocked *Cl. botulinum* spore suspensions comprising mixtures of 5 type A and 5 type B strains. Samples were then incubated at 27°C , and tested for toxin at intervals by mouse bioassay. Results, presented and discussed in detail, show that inclusion of sorbate may reduce the quantity of nitrite required, and increase overall antibotulinal activity. Products differed in suspensibility to *Cl. botulinum* toxin formation and effects of nitrite and sorbate. [See FSTA (1982) 14 8S1379.] AJDW

66

Effect of nitrite- vs. nitrate-curing on *Staphylococcus aureus*. [Lecture]

Delenyi, M.; Incze, K.; Dolozselek, H. E.; Vada, K. M.; Nagy, A.; Lombai, G.; Takacs, J.
Proceedings of the European Meeting of Meat Research Workers No. 26, Vol. II, M-4, pp. 223-226 (1980) [5 ref. En] [Hungarian Meat Res. Inst., Gubacsi ut 6/b, 1097 Budapest, Hungary]

Studies were conducted to determine effects of nitrite vs. nitrate curing on *Staphylococcus aureus* counts in hams injected and surface-treated with cultures of 4 *Staph. aureus* strains, to give a total initial count of $10^6/\text{g}$. The hams were first dry-salted, then brined; they were then heat treated at 40°C for 6 h, held at room temp. for 12 h, and stored at $12-15^\circ\text{C}$. Some were frozen and stored at -18°C for 6 wk before heat treatment etc. as above. Little effect of nitrite vs. nitrate curing on *Staph. aureus* count was observed. Little change in *Staph. aureus* count during the various stages of processing was observed, except that a slight increase occurred after thawing of the frozen samples. [See FSTA (1982) 14 8S1379.] AJDW

67

Effect of the level of residual nitrite and packaging conditions on color stability in cooked ham. [Lecture] Goutefongea, R.

Proceedings of the European Meeting of Meat Research Workers No. 26, Vol. II, M-3, pp. 219-222 (1980) [16 ref. En] [Inst. Nat. de la Recherche Agronomique, Theix, 63110 Beaumont, France]

Hams were cured in brines containing 330 or 1000 mg NaNO_2/kg , giving nitrite concn. of (i) 50 and (ii) 150 p.p.m. resp. in the cured hams. The hams were then cooked, trimmed of fat and connective tissue, and ground, 50 g aliquotes were packaged in plastics pouches under vacuum levels of 5-100 mm Hg, and stored at 10°C under illumination (daylight + fluorescent light) or in the dark. Reflectance spectrometric measurements were made and residual nitrite and pigment concn. were determined after storage for up to 18 days. Residual nitrite concn. decreased during storage, decreasing to 17% and 11% of the initial value for (i) and (ii), resp. Vacuum level did not affect nitrite depletion; light accelerated nitrite depletion. Pigment conversion increased during storage, and was greater for (ii) than for (i). Vacuum level had little effect on pigment conversion, but storage in the dark was advantageous. Colour stability is greatest in the dark, at high vacuum. [See FSTA (1982) 14 8S1379.] AJDW

68

[Inhibition of bacterial and tissue catalases by NaNO_2 and pH.]

Cantoni, C.; Redaelli, A.; Menaggia, F.

Industria Alimentari 20 (9) 598-604 (1981) [15 ref. It, en] [Istituto di Ispezione degli Alimenti di Origine Anim., Univ. degli Studi, Milan, Italy]

Recent research into the direct or indirect inhibitory effect of nitrites (or HNO_3) on bacterial cells or spores, of importance in the processing and salting of meat, is reviewed. Hypotheses on the mechanics of nitrite reaction with intercellular iron, nucleic acids and nucleotides are cited. As nitrite may combine with various enzymes, including catalases, a study was undertaken of its influence on catalase activity (assessed by a method based on detn. of residual H_2O_2), using cultures of *Salmonella typhimurium*, *Micrococcus* spp., *Pseudomonas fluorescens* and prepared samples of muscle tissue at pH varying from 5.2 to 7.3. Results (full details and graphs) showed that inhibition of the catalase activity increased considerably by increasing pH and by decreasing nitrite concn. in the substrate. KME

69

Studies on the effect of meat tenderizers on some chemical constituents of camel and buffalo meats.

Foda, Y. H.; Bassiouny, S. S.; Abdalla, M. A.; Shehata, M. I.

Mesopotamia Journal of Agriculture 15 (1) 93-111 (1980) [24 ref. En, ar] [Dep. of Food Sci., Ain Shams Univ., Cairo, Egypt]

Longissimus dorsi muscles were obtained from buffalo and camel meat immediately after slaughter,

and 100 g samples were soaked in ficin, bromelin or trypsin enzyme solutions or distilled water (control) for 2 h at room temp. then in a refrigerator at 4°C for 48 h. After 48-h samples were ground and analysed for moisture content, total N, free amino N, total soluble N, soluble protein N, soluble non-protein N, actomyosin N, myosin N, free amino acids, and pH; results are tabulated. Moisture content of buffalo meat was increased by bromelin treatment and of camel meat by ficin. Treatment with trypsin caused a pH change from 6.50 to 6.70 in buffalo meat and from 6.40 to 6.50 in camel meat; bromelin and ficin caused no noticeable change. Tenderizer treatment caused increases of soluble non-protein N in both meats, and of myosin N, water soluble N, free amino N and free amino acids, but a decrease in actomyosin N. Changes in free amino acids in *L. dorsi* muscle of buffalo and camel meats were determined in fresh meat and after cold storage at 4°C for 2, 5 and 9 days, and also in meats after trypsin and bromelin treatment for 2 and 48 h; tables of results show the presence or absence of individual free amino acids. AL

70

Effect of nitrite and sorbate on total number of aerobic microorganisms in chicken white and dark meat patties.

Bushway, A. A.; Ficker, N.; Jen, C.

Journal of Food Science 47 (3) 858-860, 863 (1982) [En] [Dep. of Food Sci., Holmes Hall, Univ. of Maine, Orono, Maine 04469, USA]

Effects of nitrite, sorbate and combinations of these 2 ingredients plus salt on the number of aerobic microorganisms in chicken white and dark meat patties were examined. All patties were stored at 4-5°C for 12 days. Nitrite concn. of 400 and 2500 p.p.m. were effective in preventing bacterial growth in chicken white meat patties, while 2500 p.p.m. was required to prevent growth in dark meat. A reduction in bacterial growth (4-10 days) was demonstrated with 100 and 150 p.p.m. nitrite in chicken white meat patties.

400 p.p.m. nitrite reduced bacterial growth in dark meat patties for 6 days. In white meat patties, use of sorbate (0.26%) in combination with nitrite (40 p.p.m.) was as effective in reducing bacterial growth at higher concn. of nitrite; salt (2.5%) alone or in combination with sorbate (0.26%) or nitrite (40 p.p.m.) inhibited bacterial growth in both white and dark meat patties during the first 4-6 days storage. IFT

71

[Meat and meat products. Determination of nitrogen content.]

Syria, Syrian Arab Organization for Standardization & Metrology

Syrian National Standard SNS 85/1977, 8pp. (1977) [Ar] [Min. of Ind., Damascus, Syria]

72

[Studies on nitrosamine in food. II. Contents of nitrate, nitrite and dimethylamine in various foods.]

Moon, B. S.; Kim, B. S.; Woo, S. K.

Report of the National Institute of Health 11, 181-189 (1974) [10 ref. Ko, en] [Dep. of Hygiene, Nat. Inst. of Health, Seoul, Korea]

Contents of $\text{NO}_3\text{-N}$, $\text{NO}_2\text{-N}$ and dimethylamine (DMA) of 46 food groups were determined colorimetrically. $\text{NO}_3\text{-N}$ was detected in all samples, its content being in the range up to 167.0 p.p.m. Out of 174 samples, $\text{NO}_2\text{-N}$ was detected in 36 samples at up to 6.0 p.p.m. which was under the limit restricted in the Food Hygiene Law of Korea. Processed meat products such as ham and boiled mackerel pike contained no DMA. KoSFoST

73

[Influence of nitrates and nitrites on keeping quality characteristics of sausages.]

Dominici, S.; Bertorotta, G.; Vizzani, A.; Severini, M.; Antonio, E. di

Industria Alimentari 20 (12) 865-867 (1981) [6 ref. It, en]

To ascertain whether use of nitrates and nitrites is really essential in sausage manufacture (i) 14 Perugino type pork sausages, prepared with addition of such compounds, and (ii) 15 sausages of the same type, prepared without such addition, were examined after 12, 24, 36 and 48 days storage. Total aerobic mesophilic counts were (i) $30\text{--}500 \times 10^6/\text{g}$ and (ii) $50\text{--}600 \times 10^6/\text{g}$. Counts of coliforms, *Streptococcus faecalis*, and staphylococci were insignificant, and counts of anaerobic S-reducing bacteria, *Salmonella*, *Clostridium perfringens* and *C. botulinum* were negative in all samples. pH values, determined by "Toptronic" pH-meter at 5 points in each sausage were (i) 5.06-5.63 and (ii) 5.13-5.55 (range); a_w , determined by "Novasina" electric hygrometer was (i) 0.975-0.795 and (ii) 0.973-0.803. The Mahalanobis distance (D) was computed at 0.645, less than the min. significant distance ($D_{0.05} = 1.157$). It is postulated that the low bacterial load is indicative of excellent hygienic state of the raw material. External inspection of outer surfaces and of inside surfaces on cutting and after 12 h at ambient temp. or at 4°C revealed the development of a grey colour at the centre of (ii) after 12 h at ambient temp., which might adversely affect sales. Otherwise all samples were equally acceptable. KME

74

[Influence of nitrate and nitrite on bacteria that cause meat spoilage and food poisoning.] Einfluss von Nitrat und Nitrit auf Bakterien, die Fleischverderbnis und Lebensmittelvergiftungen verursachen können. Kendereski, S.

Fleischwirtschaft 61 (11) 1735-1740 (1981) [23 ref. De, en] [Tech. Fac., Univ., 11 000 Belgrade, Yugoslavia]

The bacteriostatic and bactericidal effects of NaNO_3 and NaNO_2 , alone or in combination with NaCl, on meat spoilage and food poisoning organisms were investigated. The following results were obtained from in vitro tests: NaNO_3 or NaNO_2 alone, at the concn.

used in meat curing, had no effect on growth of the bacteria except for *Clostridium perfringens* and probably other anaerobes; the growth inhibition by NaNO_3 and NaNO_2 was greatly enhanced by addition of 5-8% NaCl, especially with regard to *Cl. perfringens*; NaCl alone in high concn. had a limited bacteriostatic effect (especially on *Cl. perfringens*); the effect of NaNO_3 and NaNO_2 + NaCl was particularly marked at low pH (5.8); a similar effect was observed for high concn. (8%) of NaCl. The mechanism of the synergistic action of NaCl with NaNO_3 or NaNO_2 and the role of pH is not fully understood. [From En summ.] RM

75

The isolation and characterization of nitrite reductase from *Salmonella typhimurium* and its probable role in physiological energy generation. Page, G. V.

Dissertation Abstracts International, B 42 (4) 1377-1378: Order no. 8122109, 104pp. (1981) [En] [Rutgers Univ., New Brunswick, New Jersey 08903, USA]

Various studies were made of the ability of *S. typhimurium* to assimilate inorganic N (as nitrate, nitrite or NH_3) and of the properties of nitrate reductase isolated from *S. typhimurium*. Conclusions reached from the studies were: that nitrite, at the levels currently allowed in processed meats, is not a significant factor in preventing cooked cured meat products from serving as vehicles of *S. typhimurium* food-borne illness; and that nitrate reductase functions in a dissimilatory capacity and both the formation and subsequent assimilation of NH_3 from nitrite are of secondary importance to the organism. JA

76

The behaviour of nitrates in veal calves or in weaning calves.

Bertoni, G.; Cappa, V.; Calamari, L.

Annali della Facolta di Agraria, Universita Cattolica del Sacro Cuore 21 (1/2) 85-92 (1981) [7 ref. En, it] [Fac. di Agraria, Univ. Cattolica del Sacro Cuore, Piacenza, Italy]

A total of 16 Friesian bull veal and weaning calves were used in a study on effects of administration of KNO_3 (0, 1, 5, or 10 g/day) on performance and health of the calves, and nitrate concn. in tissues, (muscle, liver, kidney, spleen, blood). Nitrate concn. in these tissues increased with increasing nitrate dose administered. The levels were, however, not sufficient to present any health hazard to consumers. Nitrite was not detectable in the tissue samples studied. AJDW

77

[Use of limited quantities of nitrite in manufacture of Italian-type sausage.]

Baldini, P.; Farina, G.; Palmia, F.; Parolani, G.; Raczyski, R. G.

Vianes et Produits Carnes 2 (3) 29-30 (1981) [3 ref. Fr] [Sta. Exp., Parma, Italy]

A procedure for manufacture of non-fermented sausages containing $\leq 2.5\%$ NaCl and ≤ 50 p.p.m. NaNO_2 is described; it is based on holding the meat at 0-3°C for several days to cause partial drying (wt. loss

approx. 9%) and incorporation of small quantities of acetic acid (insufficient to alter pH) in the mix. Studies were conducted on the microbiological quality of sausages made by these procedures and stored at 0° or -4°C. This procedure gave inactivation of clostridia, in spite of the low NaNO₂ concn., reduction by a factor of 10-100 being achieved. Addition of small amounts of acetic acid gave good control of Enterobacteriaceae, especially at low temp. and pH. Studies on such sausages inoculated with *Staphylococcus aureus* at 10⁴/g showed no growth of staphylococci at temp. <20°C. AJDW

78

[Problems in the manufacture of shelf-stable meat products.]

Vukovic, I.

Tehnologija Mesa 22 (5) 149-151 (1981) [12 ref. Sh, en] [Vet. Fak., Katedra za Tehnologiju Mesa, Belgrade, Yugoslavia]

Conditions necessary for the improvement of shelf-life of meat products are discussed. If conditions for the destruction of the undesirable microflora are observed in the course of the production process, it was established that only 50 p.p.m. nitrite was sufficient for the improvement of shelf-life of meat products. STI

79

[Effects of KNO₃ on formation of N-nitrosamines and on the microbiological quality of salami. Effects of KNO₃ on growth of the microflora during maturation of Milan-type salami.]

Schiesser, A.; Bisazza, M. C.; Cundari, E.

Rivista della Societa Italiana di Scienza dell'Alimentazione 10 (4) 221-224 (1981) [20 ref. It] [Istituto di Microbiol., Univ. degli Studi di Camerino, Camerino, Italy]

Samples of Milan-type salami were prepared with 0, 0.0625, 0.125 or 0.250 g KNO₃/kg; microbiological quality was evaluated at intervals during growth for ≤60 days. Tables and graphs of results are given. Mesophile count increased rapidly to a max. after 20 days, dropped sharply to a min. at 40 days, then showed a very slight increase. Coliform count decreased for the first 10 days, then increased sharply for the next 10 days, then decreased to very low levels. Counts of enterococci increased rapidly for the first 20 days, dropped to 4-5 × 10⁴/g after 40 days, and increased slightly to 5-6 × 10⁴/g at the end of maturation. Counts of lactobacilli increased throughout maturation; lactobacilli dominated the microflora of the ripened product. In general, the highest nitrate level gave the lowest bacterial counts. AJDW

80

Additives and contaminants in the food supply.

Elton, G. A. H.

Food Technology in Australia 33 (4) 184-188 (1981) [11 ref. En] [Min. of Agric., Fisheries & Food, London, UK]

The problems of ensuring that the nation's food supply is wholesome and safe are discussed. The assessment of short-term and long term hazards, and the toxicological testing of food additives are briefly considered. Examples considered are: the use of sodium nitrite as a meat curing additive; the use of saccharin as a sweetener; the presence of heavy metals as contaminants; and the presence of aflatoxin in mould-infested foodstuffs. VJG

81

[Properties of *Shigella* with relevance to food hygiene.] Untersuchungen über lebensmittelhygienisch bedeutsame Eigenschaften von Shigellen.

Fehlhaber, K.

Archiv für Experimentelle Veterinärmedizin 35 (6) 955-964 (1981) [32 ref. De, en, ru] [Sektion Tierproduktion & Veterinärmed., Humboldt-Univ., Berlin]

Studies were conducted to evaluate effects of NaCl, pH, temp. and nitrite on survival and multiplication of 21 strains of *Shigella sonnei* and *Sh. flexneri*. NaCl resistance was relatively poor. Low pH lead to rapid inactivation; at pH ≤4.5 survival is <24 h. No multiplication occurs at temp. <6-8°C. Heat resistance of the strains studied was relatively low. Nitrite inhibited multiplication, especially at acid pH; however, nitrite/pH combinations normally found in sausages are not likely to prevent multiplication of shigellae. In general, resistance of *Sh. sonnei* to the variables studied was greater than that of *Sh. flexneri*. IN

82

[Investigation into the possibility of reducing the contents of nitrites in sausages and ground meat preserves.]

Dordevic, V.; Bokulic, S.; Pintaric, V.; Pospisil, A.; Hak, D.

Tehnologija Mesa 21 (11) 316-319 (1980) [5 ref. Sh, en] [Jugoslovenski Inst. za Tehnologiju Mesa, Belgrade, Yugoslavia]

It was established that addition of ascorbic acid reduced the contents of nitrosamines in sausages by 50% in samples containing 10 and 30% fat, and by a factor of >4 in samples containing 40% fat. Use of 5 mg% nitrites plus 0.05% ascorbic acid is recommended. STI

83

[Investigation into the possibility of reducing the quantity of nitrite in Frankfurter-type sausages by the use of beetroot (*Beta vulgaris*) pigments.]

Milanovic, S.; Milanovic, M.; Burkus, J.; Stamenkovic, T. *Tehnologija Mesa* 21 (11) 313-315 (1980) [Sh, en] [PIK, Kikinda, Yugoslavia]

Comparative studies were conducted on batches of Frankfurter-type sausages made with (i) 50 mg NaNO₂ + 200 mg ascorbic acid/kg, or (ii) as (i), but with the addition of beetroot pigment (betalain). After storage under vacuum for 14 days at 5°C, the colour of (i) sausages was less intense than that of (ii) samples. Flavour did not differ between (i) and (ii). STI

84

[Providing colour in Brühwurst made with reduced nitrite additions.] Farbgebung bei Brühwürstchen mit verringerter Nitritzugabe.

Bucsko, M.

Fleischwirtschaft 62 (6) 759-760 (1982) [8 ref. De, en] [Hungarian Meat Res. Inst., Budapest, Hungary]

A drastic reduction in the content of NaNO_2 in meat products is suggested, with a view to avoiding the possible danger of nitrosamine production. The ratio of pigment (myoglobin, haemoglobin) to curing agent

(NO_2 , NO_3) cannot, however, be altered to any very great extent. A method is described, based on the results of model experiments, which seems to make it possible to reduce the NO_2 content of heat-treated Brühwurst products considerably whilst retaining the characteristic colour and colour stability of the finished product, by incorporating 0.3% thick bovine blood. AS

85

Effects of sodium nitrite, sodium acid pyrophosphate and meat formulation on properties of irradiated frankfurters.

Terrell, R. N.; Swasdee, R. L.; Smith, G. C.; Heiligman, F.; Wierbicki, E.; Carpenter, Z. L.

Journal of Food Protection 45 (8) 689-694 (1982) [11 ref. En] [Dep. of Anim. Sci., Texas A&M Univ., Texas Agric. Exp. Sta., College Station, Texas 77843, USA]

Frankfurters of 12 treatment combinations were made using a conventional manufacturing procedure. Manufacturing treatments included formulations of either 60% pork/40% beef, 100% mechanically deboned chicken (MDC) or 100% mechanically deboned turkey (MDT); NaNO_2 levels of 0 or 50 p.p.m.; and sodium acid pyrophosphate (SAPP) levels of 0 or 3750 p.p.m. Finished frankfurters were either not irradiated or irradiated at temp. of -34.4° or -51.5°C and dose levels of 0.8 or 3.2 Mrad. Addition of SAPP did not significantly affect external or internal colour, off-flavour incidence or overall palatability of any of the frankfurters, but significantly increased processing shrinkage for pork/beef and chicken franks, decreased frankfurter pH values for pork/beef and chicken franks, and improved texture of pork/beef, chicken and turkey franks. Addition of 50 p.p.m. nitrite, as compared to use of no nitrite, significantly decreased processing shrinkage of turkey franks, increased batter and frankfurter pH of pork/beef franks, increased consumer cooking loss of chicken franks, but decreased consumer cooking loss of turkey franks, decreased off-flavour of pork/beef, chicken and turkey franks, and improved internal colour of pork/beef, chicken and turkey franks. An irradiation temp. of -51.1° as compared with -34.4°C , decreased off-flavour intensity and increased palatability of pork/beef franks, but did not affect other properties of pork/beef franks or any of the properties of chicken or turkey franks. Franks irradiated with 0.8 Mrad differed ($P < 0.05$) from those that were not irradiated in only 3 of 18 sensory traits (including overall palatability of pork/beef franks); franks irradiated with 3.2 Mrad differed ($P < 0.05$) from those which were not irradiated in 8 of 18 sensory traits (including overall palatability of pork/beef, chicken and turkey franks). AS

86

Interaction between sample preparation techniques and three methods of nitrite determination.

Fox, J. B.; Doerr, R. C.; Lakritz, L.

Journal of the Association of Official Analytical Chemists 65 (3) 690-695 (1982) [32 ref. En] [Sci. & Education Administration, USDA, E. Reg. Res. Cent., Philadelphia, Pennsylvania 19118, USA]

Meat samples containing nitrite and varying concn. of ascorbate, cysteine, and NaCl were prepared for nitrite analysis. Methods used were the AOAC method of dilution and heating; addition of mercuric chloride, charcoal and Carrez reagents at 2 different pH values; and direct analysis of sample supernatants with no treatment (control). Effect of these initial conditions and preparation methods on measured nitrite was determined using 3 different Griess reagent combinations and chemiluminescent and differential pulse polarographic techniques. Systematic variations were observed in samples treated with mercuric chloride, while addition of Carrez reagents had little or no effect. Best results were obtained by the AOAC dilution/heating method under alkaline conditions, or by charcoal addition followed by chemiluminescent or colorimetric nitrite detn. Statistical analysis of the nitrite concn. determined in the several samples showed that these 3 procedures were precise to about 5-6% coeff. of variation (CV), which was not significantly different from the CV value of 4% determined from replicate analyses. AS

87

[Studies on the manufacturing process of cooked cured hams using a multiple pickle injector. III. Determination of suitable amounts of sodium nitrite and sodium ascorbate.]

Shinmura, Y.; Yamada, J.; Fujii, S.; Kasugaya, K.; Kohsaka, K.

Journal of Japanese Society of Food Science and Technology [Nippon Shokuhin Kogyo Gakkaishi] 28 (5) 284-289 (1981) [22 ref. Ja, en] [Japan Meat Processors' Ass., 5-6 Ebisu 1 chome, Shibuya-ku, Tokyo 150, Japan]

The amount of NaNO_2 injected into pork loins was significantly related to the level of residual NO_2^- in the cooked cured loins. In the case of short curing for 1 or 2 days, injection of 100 p.p.m. NaNO_2 gave < 70 p.p.m. residual NO_2^- , as specified by Japanese food law. Colour formation, which was directly proportional to NaNO_2 addition, was promoted by the addition of sodium ascorbate at > 300 p.p.m., and ascorbate also reduced residual NO_2^- levels. The effects of light exposure of cooked hams on the colour as measured by a Hunter colorimeter were also investigated. [From En summ.] [See following abstr. for part IV.] JRR

88

A comparison of curing practices and sodium nitrite levels on the chemical and sensory properties of smoked turkey.

Sheldon, B. W.; Ball, H. R.; Kimsey, H. R., Jr.

Poultry Science 61 (4) 710-715 (1982) [13 ref. En] [Food Sci. Dep., N. Carolina State Univ., Raleigh, N. Carolina 27650, USA]

3 different curing procedures using 2 levels of NaNO_2 were evaluated for colour, residual NO_2^- , % NaCl,

% moisture, and organoleptic quality of smoked turkey. Curing procedures included (i) soaking in a 15% NaCl brine for 48 h prior to cooking, (ii) injecting an amount of 15% salt brine equal to 10% of the carcass wt. followed by soaking in 15% brine for 24 h, and (iii) injecting brines to obtain a finished product with 2% salt and cooking immediately. Turkeys were smoked while cooking to an internal temp. of 71°C. Smoked breast meat from turkeys cured with reduced amounts of NO_2^- had significantly lower residual NO_2^- . (iii) yielded breast meat with the highest concn. of residual NO_2^- and salt. Hunter colour "a" values demonstrated no cured colour difference in breast tissues due to concn. of NO_2^- in curing brine, whereas significant colour differences resulted from cure methods. Injection with immediate cooking resulted in less uniform colour development. Product with higher levels of residual NO_2^- and salt received higher, but not significantly different, taste panel scores for cured meat flavour intensity, salt intensity, and juiciness. These results show that cured meat flavour and colour can be produced in turkey breast tissue with 25% of the max. permitted levels of NaNO_2 . The results also suggest that curing time can be reduced if more uniform colour can be obtained with direct injection of brine followed by immediate cooking and smoking. AS

was > 50% and only small amounts of free nitrite residues were left in the meat after cooking (< 0.01%). Thawed chicken meat cured more quickly than fresh muscles, possibly because of partial destruction of the structure of muscle tissues during freezing, which allows better penetration of the curing mixture. Chicken thigh muscles contained 3 × more haem than breast muscles, but the degree of interaction of haem pigments was higher in the latter. -SZ

89

[Dry curing of chicken meat.]

Mroczek, J.; Gorowska, K.

Przemysł Spożywczy 35 (5/6) 190-192, 220 (1981)

[10 ref. Pl] [Inst. Tech. Żywności SGGW-AR, Warsaw, Poland]

The effect of curing compounds on the degree of interaction between pigments and on the level of free nitrite residues in chicken meat was studied, using breast and thigh muscles from both cooled and frozen carcasses, in order to establish optimal conditions. Curing mixture was added at 2.2 kg/100 kg meat and the level of NaNO_2 varied in the range 0.3-1.5 kg/100 kg NaCl, with or without 0.2 kg ascorbic acid/100 kg NaCl. The process was carried out at 4-6°C for 24, 48 and 72 h. Total pigment concn. and that of nitroso pigments in the minced samples were determined by the Hornsey method [*Journal of the Science of Food and Agriculture* (1956) 15, 534]. Residues of free nitrites were estimated using the ISO method. The degree of interaction between pigments was calculated from the ratio of nitroso pigments to total pigments. Selected samples after 48 h curing were heated in boiling water for 20 min in order to estimate the concn. of nitroso pigments and free nitrite residues in the final product. At NaNO_2 levels of 0.0066 to 0.022% (expressed as % meat wt.) and at curing periods up to 72 h, the degree of reaction between pigments was insufficient, and the level of free nitrite residues was high (0.0137% in thigh muscles and 0.0142% in breast muscles). Addition of 0.2% ascorbic acid to the curing mixture increased the speed of nitroso pigment formation and decreased the level of free nitrite residues in cured poultry. Using nitrites in the range 0.022-0.033%, the optimum curing period was 48 h because the degree of interaction between the pigments

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